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## THE OPENING OF THE CORINTH CANAL.

AFTER many financial vicissitudes and many technical difficulties have been overcome, the Corinth ship canal is open, and offers a direct route for navigators between the Bay of Corinth and the Gulf of Ægina.

The cutting which pierces this historic isthmus is 6,300 meters long (a little less than four miles), and eleven years have been consumed in the execution of the project. Now the barrier which nature has set up to check the rapidity of communication by water has been abolished. The Mediterranean, the surface area of which is six times greater than that of France, was for many centuries the great central sea, the center of the exchange of the civilized world. This sea possesses on its shores some commercial cities of the first rank, as Marseilles, Barcelona, Venice, Genoa, Alexandria, Trieste, and Constantinople. For the ancient world it was the ground par excellence of commercial activity and rivalry.

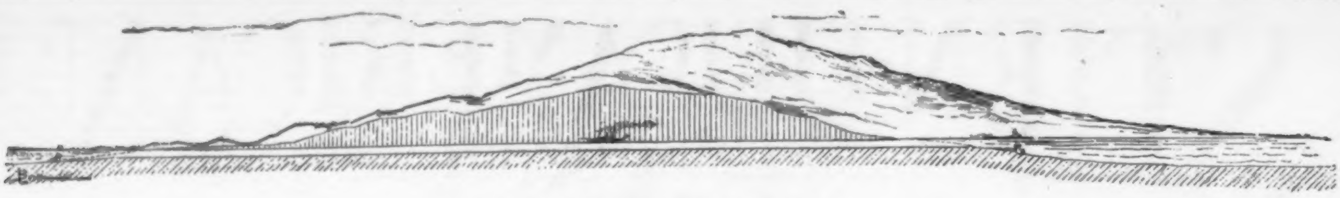
The Isthmus of Corinth is situated on the thirty-eighth degree of latitude and Cape Matapan is situated on the thirty-sixth. Vessels from the ports of France, Spain, Austria, part of Turkey in Europe, Asia Minor, the lower Danube and the Black Sea gain by traversing the canal from 180 to 345 kilometers, depending upon whether they come from the Mediterranean or the Adriatic. In the 628th year before the Christian era Periander, tyrant of Corinth, thought of piercing the isthmus. After him Demetrius Poliorcete, successor of Alexander the Great, took up the scheme again with his engineers. They made the mistake of assuming that the level of the Gulf of Corinth was higher than the level of the Gulf of Ægina, and that the piercing of the isthmus would bring on a deluge. This error is very excusable when the limited experience of the ancient engineers is considered. It is a curious fact that 2,000 years later, and after the discovery of the barometer and other instruments of precision, the same arguments were brought forward in relation to the piercing of the Isthmus of Suez. Julius Cæsar, Caligula, and later Nero, in the midst of their eccentricities, all thought of cutting through the isthmus. The great Roman Emperor Nero was haunted by the idea, and the engineers of the nineteenth century have found traces of their surveys. The fanaticism of the priests of Corinth, who prophesied disaster in connection with the old question of levels, was sufficient to cause the scheme to be abandoned. In 1829, M. Virlet d'Aoust, member of a scientific commission attached to a French expedition, brought forward the old project of the Romans and the Venetians. In 1882 M. Grimoud de Coux surveyed the isthmus anew.

On the 24th of July, 1869, in the midst of his triumph of the Suez canal, M. Ferdinand de Lesseps visited the site of the present canal, the concession for which was given, taken away from, and finally reaccorded to General Turr. This is the scheme which has now been brought to a successful issue. The Isthmus of Corinth, represented in our illustrations, taken from sketches made during the progress of the work, is 6,300 meters wide, and the highest point is eighty meters above the level of the sea. Without the comparatively easy dredging of the openings in the gulfs, the work consisted of excavating in a straight line 9,500,000 cubic meters of material, as well as quantities of talus which amounted to about 10 per cent. of the whole. This grand cutting was effected principally through massive rock, of which 5,500,000 cubic meters had to be removed with the aid of shafts and the use of the most powerful high explosives. The rest of the work was easily performed. The rock was in places blue limestone, in other places argillaceous or slightly magnesian rock; by reason of geological faults a large amount of loose matter was constantly precipitated into the cutting, so that for four kilometers of the distance a solid wall or abutment of masonry had to be built to prevent the canal being filled up. This wall had not been considered in the beginning, and added enormously to the expense. The work could not have been finished without the researches of MM. Saint-Yves, Fuchs and Quellennec. In spite of this difficulty, the great cutting was pierced through a mountain which was eighty-seven meters high, measuring from the bottom of the canal. The employment of explosive substances, powerful steam dredges and excavators, all played an important role in the great work which would have defied the thirty million laborers of Cheops. It is this explosive substance properly applied that possesses a power of destruction almost illimitable, while as far as the steam dredges, excavators, etc., are concerned each horse power represents the available energy of ten men, so that each machine will do the work of one hundred and fifty to two hundred robust men. It may be asked, What are the advantages resulting to navigation by the opening of the Corinth Canal? It would be rash to estimate the value of the canal from a commercial point of view, but the saving in time which will result from the use of the canal will prove of great value, even if the dangerous coast of Greece is not considered. For the foregoing particulars and most of our illustrations we are indebted to *L'Illustration.*

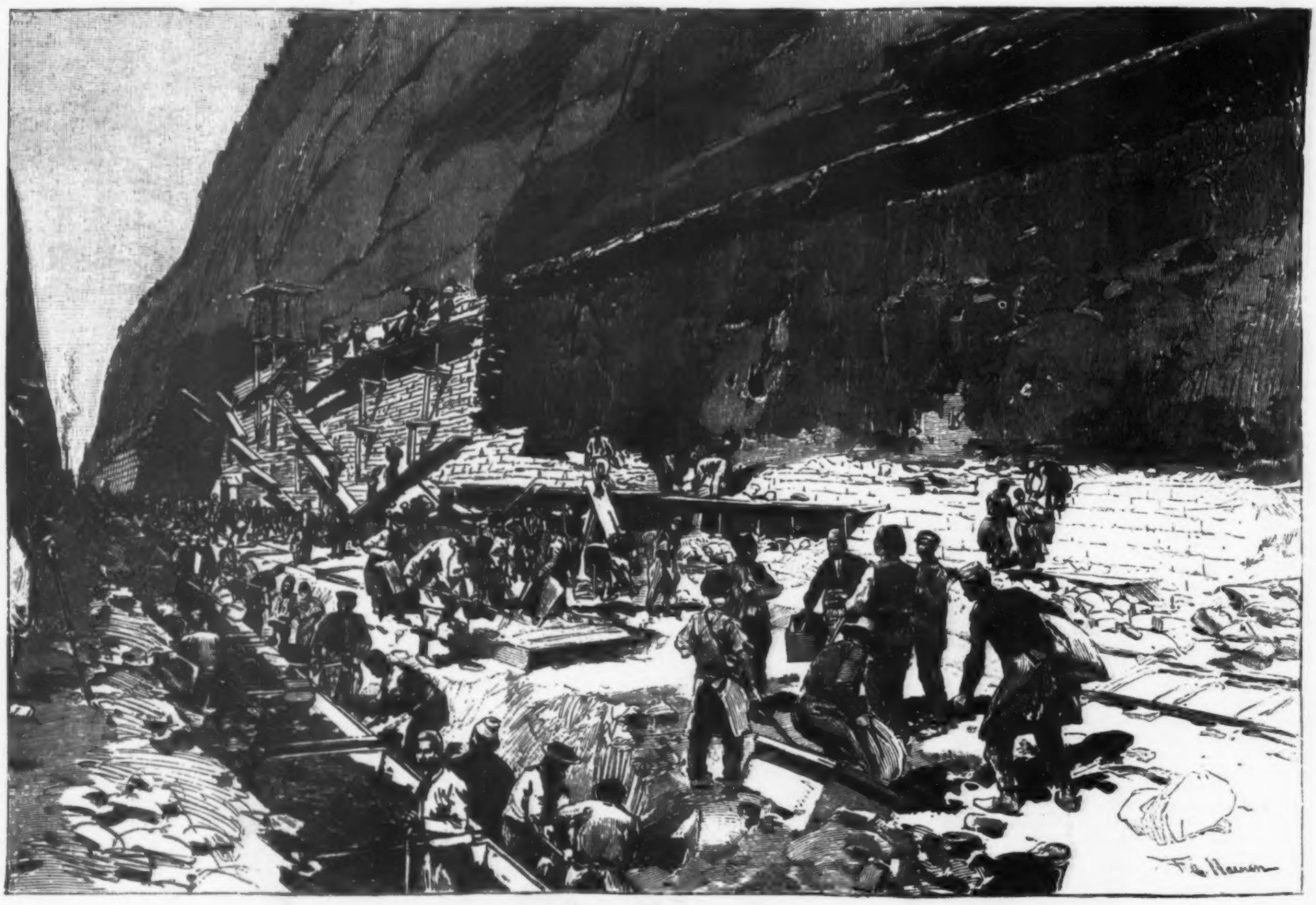
ENTRANCE TO THE CORINTH CANAL FROM THE GULF OF ÆGINA.

## THE ISTHMUS OF CORINTH CANAL.

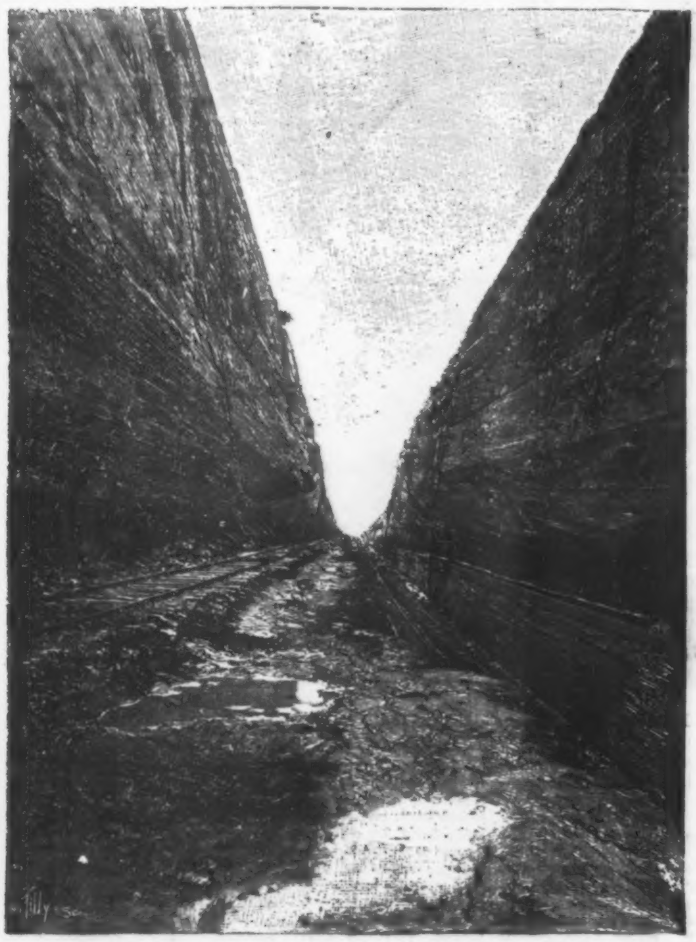
THE official opening of the new maritime communication between the Gulf of Corinth and the Saronic Gulf took place on Sunday, August 6, 1893, in presence of the King of Greece and a brilliant assemblage of distinguished persons. The new canal will not only benefit the Greek coast trade and that of Athens, but it shortens by two hundred and fifty miles the voyage from the Adriatic, from Sicily, or from Malta to Constantinople and to the Black Sea, avoiding the passage round Cape Matapan, which is often very stormy in the winter months. This important work, now accomplished by M. Matsas, a Greek engineer, for a Greek company, of which M. Syngros is president, follows exactly the line of the canal begun eighteen centuries ago, but never completed, under the Roman empire. Its length is only three miles and one-third of a mile, but the cutting had to be made in one part in a kind of sandstone rock, through high land two hundred and fifty feet above the sea level, requiring great cost and immense labor. The canal is quite straight, in a northwest direction, and a sea current runs through it at the rate, varying with the wind, of from half a knot to three knots an hour. The width at the bottom is seventy-two feet, and the depth of water will be uniformly twenty-seven feet, but at present there are two places where it is only nineteen feet; this, however, will be corrected in a month or two. There are no sidings, consequently vessels will not be able to pass each other in it. The entrance on the Corinth side is protected by two moles, the heads approaching each other and leaving a passage one hundred and fifty yards wide. At the other end, the entrance in the Bay of Kalamaki is protected by a single breakwater curving from the shore northward of it. The sides of the canal, for two miles and a half, are faced with solid masonry, and a path runs along each side. The canal is lighted along each side by electric lights, the pairs of lights being about three hundred yards apart. Two new towns, Isthmia and Poseidonia, have already been founded, one at each entrance to the canal. The bay looked very fine on the opening day, with all the vessels of war, three Greek cruisers, four torpedo



SECTION OF CORINTH SHIP CANAL.

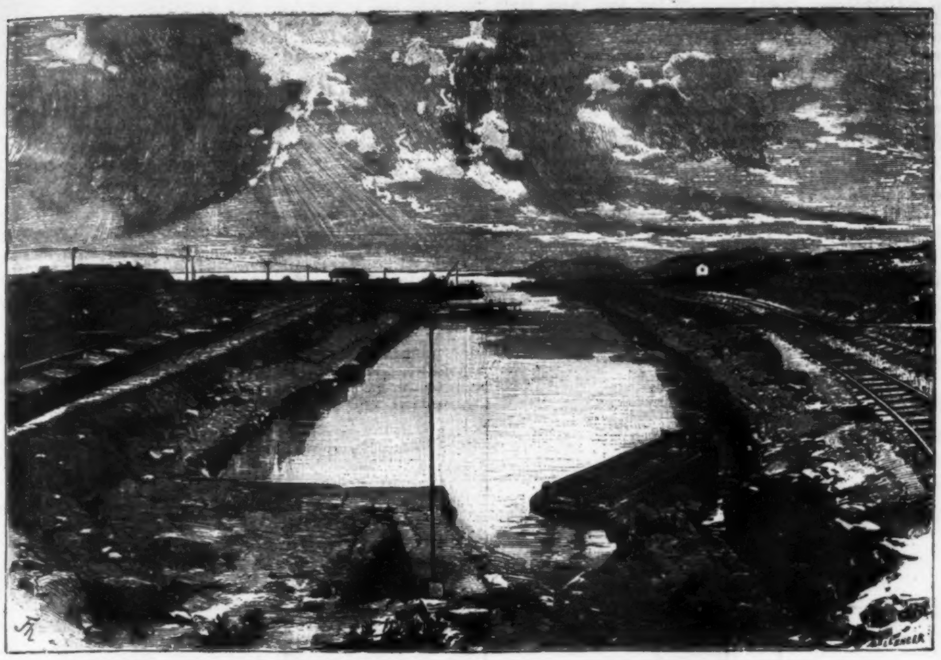


BUILDING THE WALLS OF THE CORINTH CANAL.



VIEW OF THE CORINTH CANAL LOOKING TOWARD THE GULF OF ÆGINA.

THE OPENING OF THE CORINTH CANAL.
The King of Greece steaming through the canal, with the royal standard flying.



ENTRANCE TO THE CORINTH CANAL FROM THE GULF OF CORINTH.

THE ISTHMUS OF CORINTH CANAL.

boats, three British vessels of war, and one Russian, besides several steamers, which had come from Athens for the event. There was a ribbon stretched across the entrance to the canal. The Queen of Greece cut the ribbon with a pair of gold scissors, after which the royal party re-embarked, and the procession of ships passed through: the King on board the Sphacteria, being followed by Prince George of Greece, in charge of the flotilla of torpedo boats, the Russian cruiser, and the British gunboat Sandfly, and two or three merchant steamers. A grand luncheon was served at the other end on board the King's ship, the procession returned, and the various ships went back to Phalerum Bay.—*Illustrated London News.*

## SINKING A SIPHON TRAP.

THE steam trap shown in Fig. 1 is adapted to receive the returns from a number of heating systems, al-

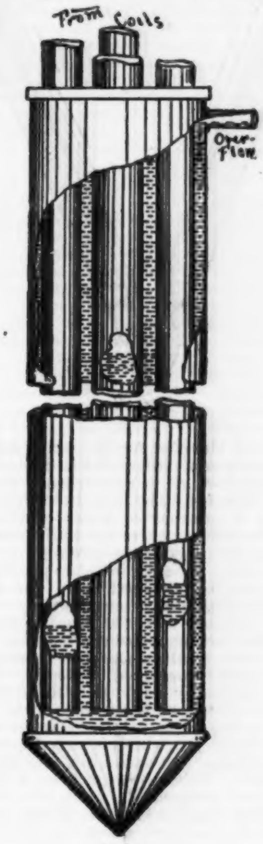



FIG. 1.

though these systems may each run under a different pressure. The trap is made long enough to equal in feet equivalent the highest pressure in the systems returning the water of condensation to it. If the pressure of steam in a system was 10 pounds, the trap would have to be somewhat over 20 ft. in length. It is made of steam pipe of 3 or 4 in. in diameter, and was more fully described in our issue of May 27. Where the pressure is high enough to require the use of a long trap, and where the returns are such that the trap must be sunk into the ground, the problem arises of sinking this length of pipe such a distance. It could be done by digging to this depth, but in the majority of cases the room available to do this is not plenty. In

VIEW OF CANAL LOOKING TOWARD THE CORINTH END.

other cases, also, the trap must be lowered in 6 ft. sections and coupled. One plan is to drive it as any pile is driven, but it would be a difficult matter to drive in this way unless the proper appliances are at hand. We have seen them driven by a heavy weight, lifted with a single block pulley, which is allowed to drop after being lifted a short distance, as in the ordinary pile driver, the pipe being rotated to keep it free and make the driving easier. The best way, we believe, is to drive it by water erosion, the pipe offering special facilities for such driving. To do this a casting, such as shown cut in two in Fig. 2, is made and fastened

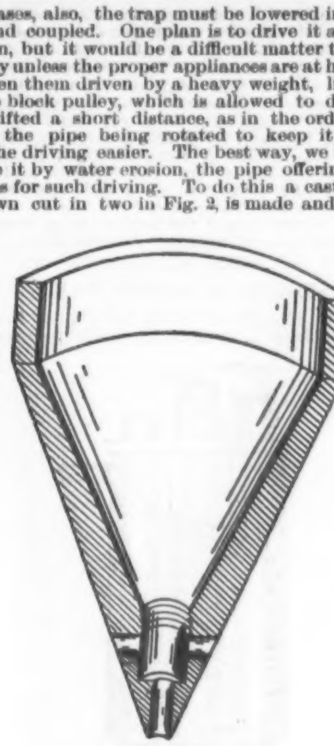


FIG. 2.

at the bottom of the pipe for the trap, and forms its point. The bottom of this point is drilled a portion of the way large enough to receive a one-half inch pipe thread, and a three-eighths inch hole drilled through the point, and a number of holes of the same size drilled from the side to enter the half inch hole. The top of the trap is capped to receive a pipe or hose conveying water under pressure into the pipe to be driven. This pressure can be obtained from the city supply where that is available or from a pump. The water, forced under pressure into the pipe, escapes from the holes made at the bottom or point of the trap and loosens the soil sufficiently to allow the pipe to sink of its own weight or by light blows from a sledge. If the pipe be rotated as it is being sunk, it will be much easier to keep it in a vertical position. This method of driving traps is the same in principle as the driving of pipes by water jet, which is very frequently done where a pile driver is not available, and is a quick and effective method. After the pipe is sunk the required depth, a half inch plug can be stuck into the end of a piece of pipe and screwed into the thread at the bottom of the point, thus preventing the escape of water from the trap.—*Boston Jour. of Com.*

## IMPROVED STEAM STRIKER.

WE illustrate a new appliance by Mr. S. W. Allen, of the Bute Docks, Cardiff, with a view to lightening the heavy labor of the "Oliver" man. This appliance he has called a steam striker. It is described in *Engineering* as follows: The general appearance of the machine is well shown in the perspective. It consists of a metal anvil, having a bracket cast on the back of it. This bracket serves to support a vibrating arm carrying the hammer head. The anvil block is provided with all the usual fittings for bolt and rivet making, etc. On the right-hand side of it is a treadle connected with a regulating valve in the steam pipe. A screwed rod passing through a lug cast on the anvil block is connected to the treadle by a pin, as shown. A spiral spring on this rod, compressed between the upper fly nut and the lug, keeps the treadle lever normally in the raised position in which steam is cut off. At the same time a fly nut below the lug can be used as a stop, limiting the rise of the treadle to a point such that the steam will not be entirely cut off, but sufficient will be supplied to keep the hammer in the raised position. A section through the steam cylinder is shown in Fig. 2. From the latter it will be seen that this cylinder is in shape a sector of a circle, and the piston vibrates to and fro in it.

This piston is in one piece with the main shaft, to the

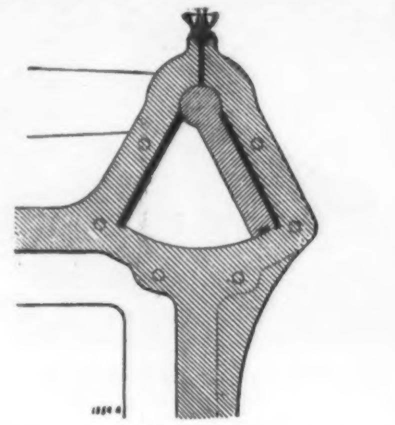


FIG. 2.

outer ends of which the side arms carrying the hammer head are keyed. Stuffing boxes are used to keep this shaft steam tight in its bearings. The piston is packed with brass strips forced against the walls of the cylinder by spiral springs. The valve is of the piston type, and is worked by a short lever moved by an arbor, which passes through a stuffing box, and carries on its other end a couple of cam followers which bear against a couple of cams fixed on the outer end of the main shaft, and the stroke of the hammer can be regulated from 3 in. up to 2 ft. 6 in. by shifting these cams relatively to each other. With steam at a pressure of 35 lb. or 40 lb. per square in., it is said 500 blows a minute can easily be made by the striker.

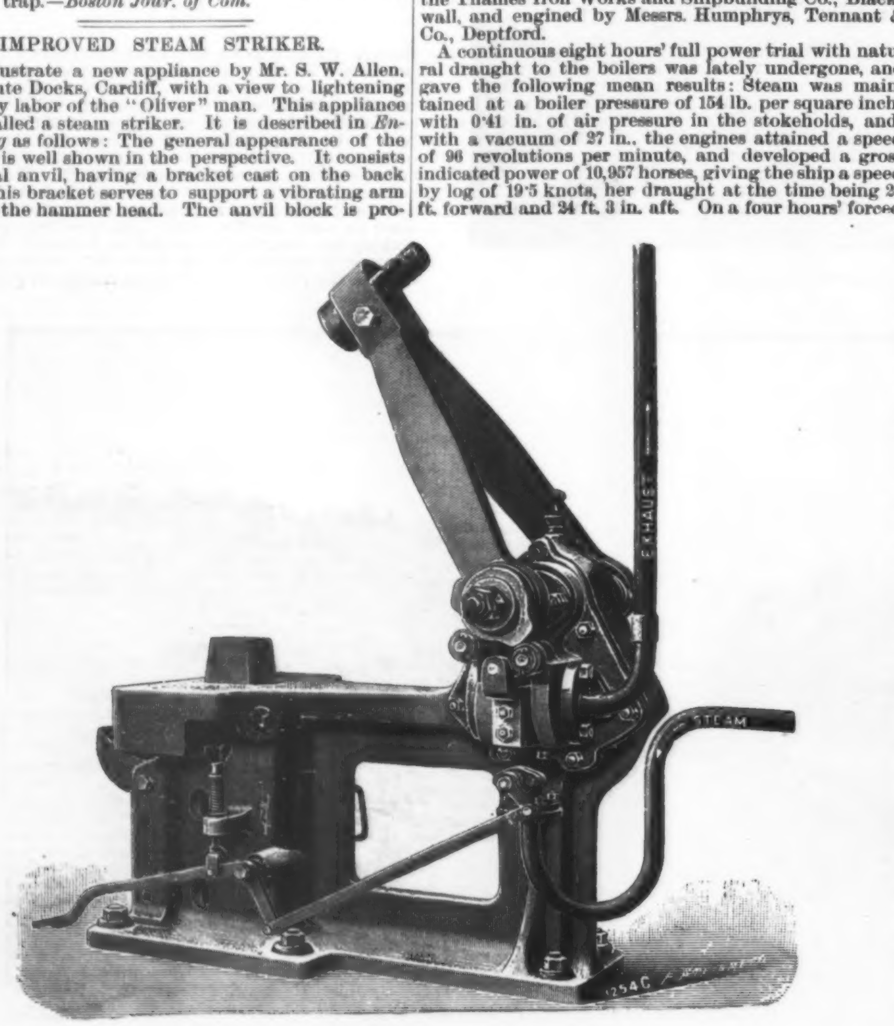



FIG. 1.—IMPROVED STEAM STRIKER.

## THE BRITISH PROTECTED CRUISER GRAFTON.

THE Grafton is the last completed of the nine first class protected cruisers ordered to be built under the Naval Defense Act of 1889. She was designed by Mr. W. H. White, Director of Naval Construction, built by the Thames Iron Works and Shipbuilding Co., Blackwall, and engined by Messrs. Humphrys, Tennant & Co., Deptford.

A continuous eight hours' full power trial with natural draught to the boilers was lately undergone, and gave the following mean results: Steam was maintained at a boiler pressure of 154 lb. per square inch, with 0·41 in. of air pressure in the stokeholds, and, with a vacuum of 27 in., the engines attained a speed of 96 revolutions per minute, and developed a gross indicated power of 10,957 horses, giving the ship a speed by log of 19·5 knots, her draught at the time being 23 ft. forward and 24 ft. 3 in. aft. On a four hours' forced draught full power trial the results were, with 1·16 in. of air pressure in the stokeholds, a good supply of steam was maintained at a boiler pressure of 148 lb. per square inch, the mean vacuum was 26·7 in., the revolutions of the engines, which were remarkably uniform, reached a mean of 101·6 per minute, and the total I. H. P. developed by them was 13,484, the speed of the ship taken at half hour intervals by log being 20·5 knots. The trials gave an excess in power developed by the engines over that contracted for of 957 I. H. P. for the natural draught, and 1,484 for the forced draught trials.

The Grafton is a cruiser of the Edgar class. She is 360 ft. long between perpendiculars, has a moulded breadth of 60 ft. and a mean load draught of 23 ft. 9 in., at which her displacement is about 7,400 tons. She is fitted with two three-bladed gun metal screw propellers 16 ft. 9 in. diameter, each driven by a triple expansion engine of the three-cylinder type, designed to develop a gross indicated power of 10,000 horses under natural draught and 12,000 horses under forced draught. Both the trials of her machinery under the conditions imposed are considered to have been highly successful, and the results satisfactory.

## THE GERMAN TAR DISTILLING INDUSTRY.

IN describing the various chemical exhibits from Germany at the World's Fair, *Kuhlow's Review* gives an account of the tar distilling industry in that country, which is treated under the following headings:

(1) The obtainment and working up of wood tar which is carried out in the richly wooded districts of Germany (Hess, Alsace, Silesia). Dry beech wood is distilled in retorts. The residual charcoal finds a good market, and the distillate is utilized for the preparation of methyl-alcohol, acetic acid, acetone and creosote.

(2) The distillation of brown coal or lignite is exclusively carried out in the Prussian province of Saxony. The coal is slowly heated in special retorts, the residual coke (Grude) is used for burning purposes, and from the distillate are extracted paraffin, solar oil and lubricating oils. In the year 1880, in the 20 factories of the province of Saxony, with a total number of 1,036 retorts, 9,458,603 tons of lignite were distilled, yielding 48,421 tons of tar. From these were obtained:

| | | |
|---|---|---|
| 7,500 | tons | paraffine |
| 700 | " | solar oil |
| 50,000 | " | lubricating and gas oils |
| 1,500 | " | creosote and asphaltum |

total value ten million marks.

(3) The distillation of the tar obtained as a by-product in the manufacture of gas. This manufacture has undergone vast expansion and generalization in Germany, although the consumption of gas per head of the population has not reached by a long way the figures which hold good for England, France, and the Eastern States of North America. The largest consumption of gas takes place in the Rhine country and the large towns of North Germany. By fractional distillation and purification of the raw products, the following are the principal substances obtained:

(*a*) Light tar oils containing benzol, toluol, and xylol.
(*b*) Phenol.
(*c*) Naphthaline,
(*d*) Anthracine,
(*e*) Creosote oils,
(*f*) Pyridine.

The first four on the list are the raw materials of the manufacture of artificial coloring matters and chemical preparations, the creosote oils are used for the pickling of railway sleepers, and pyridine finds its application in the so-called denaturation of alcohol.

(4) The manufacture of coke with saving of the by-products. This recently established and rapidly developing industry is similar in principle to the manufacture of gas, but turns out coke for blast furnaces as a main product; the gas obtained is used as fuel for the ovens, and the vapors thrown off by the coal are condensed as in gas making. The tar thus obtained is further worked up like gas tar, and yields the same products. The consumption of tar distillates is so large in Germany that considerable quantities are still being introduced from England, France, and the United States.

(5) The refining of crude petroleum, which may be looked upon as a product of dry distillation carried on in the interior of the earth. There are three petroleum districts in the German empire, but none of them bear comparison with either the Caucasian or American districts. They are therefore quite unable to cover the consumption in Germany. In 1885, 41,000 barrels of crude oil were obtained from the German wells. A number of works is engaged in the purification of this material, as well as of crude oil imported from abroad.

## LINSEED OIL VARNISH.

EXPERTS will usually claim to be able to distinguish linseed oil from linseed oil varnish at sight. The task becomes more difficult however when mixtures of these substances have to be dealt with. To distinguish a poor oil from one containing 25 per cent. of varnish, the following plan was recommended a short time ago by Finkener: A 20 per cent. solution of ammonia is prepared. Another test solution is made containing 100 grammes of lead acetate and 32 grammes of glycerol in 120 c. c. of water. The method of operation is performed thus: 1 c. c. of the ammonia solution is mixed with 5 c. c. of the lead solution, 12 c. c. of the suspected oil is added, and the whole is vigorously shaken together and then heated for three minutes at 100° C. On standing, if the sample be pure linseed oil, it will form two layers, the lower one clear as water, while if the sample contain varnish, it will set to a soft viscous mass. Bleached linseed oil varnish may sometimes be mistaken for linseed oil in color behavior, but it is really a pale yellow, and in its reactions with the above agents it behaves just like the ordinary linseed oil varnish. With the usual solvents and saponifying agents it is a matter of some difficulty to differentiate the one from the other. It is sometimes useful to know the state of oxidation of a linseed oil varnish, and for this object the following test, which has recently been proposed by W. Fahrion,

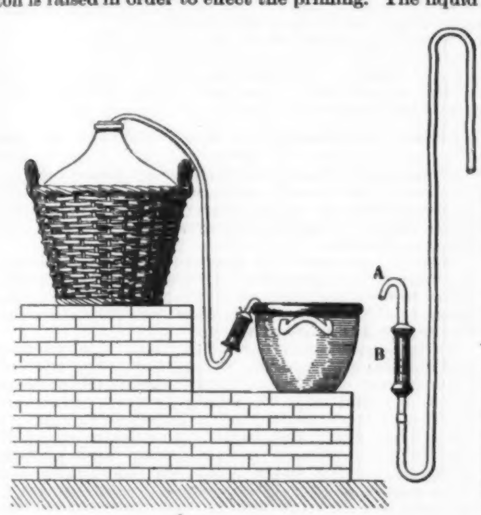
will be found sufficient. It is based upon the fact first noticed by Fahriom, that the unsaturated fatty acids on oxidation yield compounds which are insoluble in light petroleum, and may in this manner be separated from the saturated fatty acids or their oxy products. The examination is carried out thus: About 3 to 5 grammes of the varnish is weighed out and saponified by means of 15 to 25 c. c. of 8 per cent. alcoholic potash. After the spirit has been completely expelled, the soap is dissolved in 50 to 70 c. c. of hot water, and then transferred to a half liter separating funnel. After decomposing the soap by means of hydrochloric acid and subsequently cooling, the whole is shaken with 100 c. c. of light petroleum and allowed to remain for about an hour. The aqueous fluid is now completely drawn off, and if any oxy-acids are present, they will be found adhering to the sides of the funnel. The clear petroleum layer is next drawn off, and after washing two or three times with light petroleum the oxy-acids are dissolved in a little hot alcohol and transferred to a tared dish. After expelling the alcohol the residue is finally dried for an hour at 100-105° C. The amount of oxy-acids found by Fahriom in various samples of linseed oil varnish varied from 0·6 to 31·6 per cent.

## THE SUCKING UP OF DANGEROUS LIQUIDS BY SIPHON.

ALL those who manipulate dangerous liquids, especially acids, in the industries, know with what difficulties and responsibility the operation is attended. The difficulty of decanting is overcome by the use of the siphon, but the management of this simple apparatus even is not easy, and the priming of it is always more or less difficult despite the use of accessory parts, which in most cases complicate it without remedying the principal inconveniences.

Mr. Emile Muller has made a communication to the Industrial Society of Mulhouse that merits particular notice. He recommends an aspirator which he has had patented, and which, while it leaves the siphon its primitive simplicity, permits of a rapid drawing off of the most diverse liquids without danger.

The apparatus operates as follows: The aspirator, B, being adapted to a siphon of any sort of material, the orifice, A, is closed with the finger, and the piston is raised in order to effect the priming. The liquid




APPARATUS FOR DECANTING LIQUIDS.

is sucked up, fills the siphon and flows through the rod of the piston.

As the liquid flows through the curved nozzle it suffices to hook the latter to the rim of the vessel to be filled, as shown in the figure.

In order to interrupt the flow, it suffices to raise the pump to the level of the upper liquid. The stoppage is immediate, and as the siphon remains primed, it is possible to finish or resume the operation at will. When it is a question of strong acids, asbestos is used as a lining for the piston.—*Le Genie Civil.*

## THE GREAT POPULOUS CENTERS OF THE WORLD.

By Gen. A. W. GREELY.

THE astonishing growth of urban population in the United States during the past decade induced the writer to cursorily examine the tendencies of other countries in this direction, which developed facts indicating very clearly that it is a general and not local migration.

In conducting the research, lists were made of the 500 or more cities in which the population exceeds 50,000, in which doubtless live one-fifth of the 1,480,000,000 which make up the population of the world. From this list have been selected the hundred cities having the greatest number of inhabitants, and with one exception (Canton), no place has been included unless its population has been determined by census. In general, the figures here given agree with those in that most excellent publication, "The Statesman's Year Book." The census year is not uniform, and as it may be said that the growth of cities outside of the United States lies, in general, between 1 and 2 per cent. annually, the order of rank here given is not absolute.

Of the 500 cities with a population above 50,000, the countries having the greatest number are: United States, 85; India, 76; Great Britain, 72; Germany, 47; Russia, 34; France, 33; Japan, 17; Spain, 16; Austria-Hungary, 15; Italy, 14. Four-fifths of all are situated in these ten countries, and one-sixth in the United States. No less than three of the ten cities having 1,000,000 of inhabitants are in the United States, and also four of the sixteen great population centers of the world. This last designation is here given to cities of more than 750,000, this dividing line in rank being at once apparent, as there are practically no cities with population between 500,000 and 750,000.

*List of the Most Populous Cities by Last Census.*

| Rank. | Census year. | | Population. |
|---|---|---|---|
| | 1891 | "Greater London," Eng. (outer ring) | 5,633,332 |
| 1 | 1891 | London, Eng. (registration) | 4.211,056 |
| | | London, Eng. (central area) | 1,022,529 |
| 2 | 1891 | Paris, France | 2,447.957 |
| 3 | 1890 | "Greater New York," U. S.* | 3,250,000 |
| | 1892 | New York, U. S | 1,801,639 |
| 4 | | Canton, China (estimated) | 1,600,000 |
| 5 | 1890 | Berlin, Germany | 1,579,244 |
| 6 | 1891 | Vienna, Austria | 1,389,684 |
| | 1891 | Vienna, Austria | †1,364,548 |
| 7 | 1891 | Tokio, Japan | 1,161,800 |
| 8 | 1890 | Chicago, U. S | 1,099,850 |
| 9 | 1890 | Philadelphia, U. S | 1,046,964 |
| 10 | 1889 | St. Petersburg, Russia (in winter) | 1,003,315 |
| | 1889 | St. Petersburg, Russia (in summer) | 845,315 |
| 11 | 1892 | Brooklyn, U. S | 957,163 |
| 12 | 1885 | Constantinople, Turkey | 873,565 |
| 13 | 1891 | Calcutta, Ind. (excl. Howrah, 129,800) | 840,130 |
| 14 | 1891 | Bombay, India | 804,470 |
| 15 | 1891 | Glasgow, Scotland | 792,728 |
| | | Glasgow, Scotland | †565,714 |
| 16 | 1884 | Moscow, Russia | 753,469 |
| 17 | 1891 | Buenos Ayres, Argentine Republic | 561,160 |
| 18 | 1891 | Liverpool, England | 517,591 |
| 19 | 1890 | Budapest, Hungary | 506,384 |
| 20 | 1891 | Manchester, Eng | 505,343 |
| 21 | 1891 | Melbourne, Victoria | 491,378 |
| 22 | 1891 | Osaka, Japan | 483,609 |
| 23 | 1891 | Brussels, Belgium | 482,268 |
| 24 | 1887 | Madrid, Spain | 472,228 |
| 25 | 1891 | Warsaw, Russia | 465,272 |
| 26 | 1881 | Naples, Italy | 463,172 |
| 27 | 1890 | St. Louis, U. S | 451,770 |
| 28 | 1891 | Madras, India | 449,950 |
| 29 | 1890 | Boston, U. S | 448,477 |
| 30 | 1890 | Baltimore, U. S | 434,439 |
| 31 | 1891 | Birmingham, Eng | 429,171 |
| 32 | 1890 | Amsterdam, Netherlands | 417,539 |
| 33 | 1891 | Lyons, France | 416,029 |
| 34 | 1891 | Marseilles, France | 403,749 |
| 35 | 1891 | Sydney, New South Wales | 386,400 |
| 36 | 1891 | Copenhagen, Denmark | 375,251 |
| | | Copenhagen, Denmark | †312,387 |
| 37 | 1882 | Cairo, Egypt | 368,108 |
| 38 | 1891 | Leeds, Eng | 367,506 |
| 39 | 1890 | Leipzig, Germany | 353,272 |
| | | Leipzig, Germany | †293,525 |
| 40 | 1891 | Dublin, Ire. (Metrop. police dist.) | 361,891 |
| | | Dublin, Ireland | †254,709 |
| 41 | 1890 | Munich, Germany | 348.317 |
| 42 | 1890 | Breslau, Germany | 335,174 |
| 43 | 1890 | Hamburg, Germany | 329,923 |
| 44 | 1890 | Mexico, Mexico | 329,535 |
| 45 | 1891 | Sheffield, Eng | 324,243 |
| 46 | 1890 | Odessa, Russia | 313,687 |
| 47 | 1891 | Haidarabad, India | 312,390 |
| 48 | 1890 | San Francisco, U. S | 298,993 |
| 49 | 1884 | Kioto, Japan | 297,527 |
| 50 | 1890 | Cincinnati, U. S | 296,908 |
| 51 | 1881 | Milan, Italy | 295,543 |
| 52 | 1890 | Cologne, Germany | 281,273 |
| 53 | 1892 | Buffalo, U. S | 278,727 |
| 54 | 1890 | Dresden, Germany | 276,085 |
| 55 | 1872 | Rio de Janeiro, Brazil | 274,972 |
| 56 | 1881 | Rome, Italy | 273,268 |
| 57 | 1891 | Lucknow, India | 273,090 |
| 58 | 1887 | Barcelona, Spain | 272,481 |
| 59 | 1890 | Cleveland, U. S | 261,353 |
| 60 | 1891 | Edinburgh, Scotland | 261,261 |
| 61 | 1891 | Belfast, Ireland | 255,896 |
| 62 | 1890 | Bordeaux, France | 252,415 |
| 63 | 1890 | Stockholm, Sweden | 246,564 |
| 64 | 1878 | Lisbon, Portugal | 246,343 |
| 65 | 1890 | New Orleans, U. S | 242,039 |
| 66 | 1890 | Pittsburg, U. S | 238,617 |
| 67 | 1890 | Washington, U. S | 230,392 |
| 68 | 1881 | Turin, Italy | 230,183 |
| 69 | 1891 | Antwerp, Belgium | 227,225 |
| 70 | 1891 | Benares, India | 222,520 |
| 71 | 1876 | Bucharest, Roumania | 221,805 |
| 72 | 1891 | Bristol, Eng | 221,665 |
| 73 | 1891 | Hong Kong, China | 221,441 |
| 74 | 1891 | Montreal, Canada | 216,650 |
| 75 | 1891 | Bradford, Eng | 216,361 |
| 76 | 1891 | Nottingham, Eng | 211,984 |
| 77 | 1890 | Rotterdam, Netherlands | 209,136 |
| 78 | 1890 | Detroit, U. S | 205,876 |
| 79 | 1887 | Palermo, Italy | 205,712 |
| 80 | 1891 | West Ham, Eng | 204,902 |
| 81 | 1890 | Milwaukee, U. S | 204,468 |
| 82 | 1890 | Magdeburg, Germany | 202,235 |
| 83 | 1891 | Lille, France | 201,211 |
| 84 | 1882 | Alexandria, Egypt | 200,755 |
| 85 | 1885 | Santiago, Chile | 200,000 |
| 86 | 1891 | Kingston-on-Hull, Eng | 199,991 |
| 87 | 1888 | Havana, Cuba | 198,261 |
| 88 | 1891 | Salford, Eng | 198,136 |
| 89 | 1888 | Riga, Russia | 195.668 |
| 90 | 1891 | Delhi, India | 193,580 |
| 91 | 1888 | Kharkoff, Russia | 188,469 |
| 92 | 1891 | Mandalay, India | 187,910 |
| 93 | 1891 | Newcastle, Eng | 186,345 |
| 94 | 1891 | Singapore, Singapore | 184,554 |
| 95 | 1890 | Prague, Hungary | 184,109 |
| 96 | 1891 | Kieff, Russia | 183,640 |
| 97 | 1891 | Cawnpore, India | 183,210 |
| 98 | 1891 | Newark, U. S | 181,830 |
| 99 | 1891 | Toronto, Canada | 181,220 |
| 100 | 1891 | Rangoon, India | 181,210 |

* Mr. Henry Gannett's figures; this volume, p. 31.
† Excluding suburbs.

In view of the preponderating influence exercised by great cities upon the progress and welfare of the world, it is extremely interesting to note that more than one-half of the cities herein named are either populated by English-speaking races or are under their control. Of these 52 cities, two are in Australia, two in Canada, one in China, two in Egypt, thirteen in England, ten in India, two in Ireland, two in Scotland, one in Singapore, and seventeen in the United States.

It is not the purpose of this sketch to investigate the causes which particularly favor the enormous aggregations in modern cities, for such causes must be complex, local, and numerous. It is evident, however, at a glance, that the elements of easy transportation and a moderately rigorous climate are the most frequent concomitants, if they are not the predominating causes. As some one not very wisely remarked, "it is fortunate that great rivers run by so many great cities," and in this list but few cities are found which have not facilities for water transportation. By far the greater number of large cities are situated climatically in an average temperature between 45 and 55°. In the parts of Europe and America where these annual temperatures prevail there is one city of 100,000 inhabitants to about every 2,000,000 of population. In Russia there is only one such city to over 9,000,000, and in India one to over 10,000,000 souls.

With but few exceptions the populous cities of the world are the product of the age, as is illustrated by the fact that at the beginning of this century the United States had no city of 100,000 inhabitants, while now it has 28; England had 1 only, now it has 24.—*Nat. Geog. Mag.*

## SCIENTIFIC TERMS.

As many who work without a tutor are often disheartened at the unusual words they encounter, a few friendly hints may be acceptable, because reassuring: "*Hinc illæ lacrymæ.*" Science terms are chiefly derived from Greek and Latin, that lend themselves with facility to the purpose; what otherwise could only be circuitously and perhaps harshly expressed is then framed in a direct manner and euphoniously. Such terms, moreover, have general application, and are understood "from Indus to the Pole;" vernaculars have but limited use. On this account a prescription in Latin can be interpreted anywhere; it is not "caviare to the general," but how few are able to "do as they do in Rome."

From this it is evident that to dig up roots and learn prefixes and suffixes is profitable reading, the origins of words are then found and their meanings comprehended. Etymology is thus an important aid in study; what was abstruse becomes clear, and elementary difficulties disappear like fog before the sun's rays. All branches of science anastomose to form completeness, the separate parts fitting in to form a great plan, just as the disjointed pieces of a dissected map may be dovetailed to represent an entire country; hence in learning what at the time may be thought only pertinent to a section will be found of value (certainly not useless or irrelevant) to the finished work. Of course, to merely learn a science term by rote, and there an end, is to be indolently superficial, and in the position of the unobservant of whom it is said

"A primrose on the river's brink
A yellow primrose was to him—and it was nothing more."

But what a wealth of advanced botany does it not include. While for purposes of study and composition it is essential that fearful and sesquipedalian words be employed; when time shall serve they will be found so lucid and apposite as to warrant them becoming household words and the best to employ. Many are now incorporated with, enriching our language, and are in daily use, though thought uncouth at their birth; and so intelligible and appropriate are they that their discard (even if possible) would be inconvenient. Of the hundreds that crowd for precedence as examples, "orient pearls at random strung," take but a few to realize this fact; telegram, photograph, microscope, atmosphere, philosophy, thermometer, aneroid, phylloxera, chalybeate, electrolysis, cryophorus, lucifer, theodolite, toxicology, geography, numismatics, trigonometry; their etymology is not more difficult than that of the words you now encounter; it is of the same kind. How expressive are such words, how concisely they convey what is intended; they are familiar, these you first meet with in your studies, strange the only difference. By pursuing the study recommended the Slough of Despond ceases to have terrors, it becomes so filled in indeed as to present the safety of a firm macadam; moreover, this verbal agriculture provides much collateral information, and the horizon of knowledge is correspondingly enlarged. It is evident, too, that were authors to stop and explain intrinsic terms, books would become bulky and tedious to read; students are expected to understand them or to diligently dissect them, and so animate what otherwise would be indeed dry bones.

Everything, however, is comparative; what now is intelligible was obscure, what to-day seems difficult, to-morrow may render easy to be understood. Progress soon assures the industrious that he is relatively better informed than is the idle; that he knows more than does the novice, who in turn will occupy a similar position to his junior. Thus to the advanced there is no difficulty in the phrase: Teratology may be displayed by apostasis in Lonicera, by gymnaxony of the placenta in Cuphea platycentra, by peloria in Tropæolum and by erration in Leontodon; to tyros there will be amazement and perplexity when they "consider the lilies, how they grow," finding them to be monocotyledons sub-classed as petaloideæ hypogynæ, with introse anthers, trilocular ovaries, having axile placentation, and fruit either indehiscent or a loculicidal capsule. How delightful when, like "swift Camilla o'er the plain," we skim airily over now obvious simplicities.

Every branch of science has its intrinsic nomenclature, the etymology of which should be searched out as occasion requires; a few examples, however, are given as an incentive, as showing the value of what has been stated; their familiarity also may disarm indifference. In mineralogy we find carnelian, a flesh-colored stone; celestine, a strontium mineral, is sky blue; pyrope has the appearance of fire; stalactites result from trickling drops; anthracite, a burning coal (hence anthrax and carbuncle, inflamed tumors)·

amethyst, against drunkenness; a supposed prophylactic (this stone was the emblem of the tribe of Dan, in Hebrew, a judge; hence "sober as a judge" is apposite). Selenite, pale as the moon; psilomelane, a manganese mineral, smooth black in color and appearance. Some minerals and metals, *e. g.*, gold, crystallize as rhombic dodecahedra, solids with twelve diamond-shaped faces. In zoology a snail is a gasteropodous mollusk, a soft belly-footed creature; megascolides is the great earth-worm; butterflies having scale wings are lepidoptera, beetles sheath wings, coleoptera; fleas, having no visible or apparent wings, are aphaniptera.

Some fishes are acanthopterigynous, having spiny fins; ganoids have scales of splendor; the oyster belongs to lamellibranchiata, and so on. The words when dissected to show their origin are quite divested of harshness and complexity; rather are they invested with euphony and simplicity.

Chemistry is likewise rich in expressive terms; pyroligneous acid, made from wood by the aid of fire; crysophanic, I appear golden, etc.; but modern names are rather compound words, devised to give genealogy, constitution, structure, and as much information as possible; on which account, too, substances get improved titles in accordance with requirements; for example, hydroquinone is still known as such to photographers as a developer; a better chemistry title is quinol, while in full terms of its development it becomes paradihydroxy-benzene, from which a mental picture of its structure is at once seen and can be drawn. So also tetrahydroxymethylanthraquinone is explicit, and the yellow dye known in trade as orange iii is the ammoniodimethylamidoazobenzenesulphonate, only that and nothing more, but lucid to a degree.

Botany, that science of hard words, as it has been called, is fruitful in terms and appellations whose etymology is interesting; for example, erythroxylon, redwood; hæmatoxylon, blood redwood, and melanoxylon, blackwood, are very familiar. Liriodendron, tulip tree; toxicodendron, poison tree; xanthorrhea, yellow exudation; cremocarp, hanging fruit, rachis (the spine), axis of inflorescence; replum, panel of a door; mesembryanthemum is midday flowering sprouts; actinenchyma, radiate tissue; atractenchyma, collenchyma and bothrenchyma are respectively spindle shaped, gluey (when moist) and pitted tissue.

Gladiolus (accent on the *i*) has sword-like leaves; atriplex, without nourishment, refers to the arid soil on which it grows; the plant is eminently nutritious, the salt bush of the squatter.

Eucalyptus has a well-covered calyx; E. melliodora should be the honey-scented species, but, as Sir Ferdinand Baron von Mueller pathetically deplores its vernacular, is yellow box, though no part of it is yellow, not even the wood; and it resembles the real boxwood in no way whatever; lucus a non lucendo.

Bellis perennis is the ever pretty daisy. Leucojum vernum, the white violet of spring, slightly misleading.

Diosma, divine odor, is synonymous with barosma, heavy odor; de gustibus non est disputandum.

Shakespeare's "fat weed that rots itself at ease by Lethe's wharf," was doubtless a pinguicula. Euonyme, mother of the Furies, was probably well named; the familiar glucoside is scarcely so ransacking. Atropos, a Fate, lives in atropa and the deadly alkaloid; action inevitable.

Sarsaparilla is Spanish for a bushy little vine, which it somewhat resembles.

Anacampseros, to cause renewal of love, a philter "far above rubies."

Dipterix odorata, odoriferous two-winged tonka (not tonquin) bean; pterocarpus, winged fruit; ammophila, sand loving, shows its habitat; and A. arenaria grows on the coast (the convincing ground of the Romans being sprinkled with sand, got the name arena therefrom; modern folk prefer sawdust).

Nepenthe soothes, no grief; ebony from Hebrew for a stone, hard and dense; dipsacus, the teasel, I am thirsty, has connate leaves that retain water.

Nerium oleander prefers moisture; hydrangea, a water vessel, is a Chinese marsh plant; polyanthus (not polianthus) is a city flower; zostera is a girdle; potamogeton, a river neighbor.

Gelanthus, milk white flower; G. nivalis, snowdrop; illicium a charmer, attractive odor of anise; amomun, warmth, includes many species; scitamineæ, delicacies; temulentum, drunkenness; Lolium temulentum, the darnel, maliciously distributed to the English soldiery at the siege of Orleans; cyclamen has a spiral peduncle; the etymology recalls cycle, cycloid, cyclone, Cyclops, Cyclades, cylinder, cyclorama.

Genista has kneed branches, the broom (emblem of the Plantagenet kings, a thorny race also).

Calluna, I cleanse, the heather used for brooms; briza, nodding grass; cetraria, targelike thallus; narthex, a hollow stem and ferula, to strike, readily recall the N. O.; alopecuras, fox-tail grass; bougloss, ox tongue (bovril ox force, var. beef tea, the latter syllable a humorous invention of Lord Lytton); myosotis, mouse ear; chenopodium, goose foot; cyanodon, dog tooth; ophioglossum, adder's tongue; menispermum, crescent seed; pyros being wheat, melampyrum is black wheat; melaleuca, black trunk, white branches; pittosporum, seeds (enveloped in) pitchy juice; dasycarpus, hairy fruit; chrysanthemum, golden yellow flowers.

Asparagus, leaves torn, or perhaps tremble in the breeze; anemone, petals shaken by the wind; anemophilous plants, those the wind loves to aid in fertilizing; tropæolum, trophy plant, has helmet-shaped petals and shield-like leaves; agraphis, petals not marked; while graphidæ are lichens covered with what simulate Oriental writings (so graphic, granite and graptolites among minerals, of course due to quite other causes); helianthus, sunflower, model of the popular idea of our luminary, an emblem also of constancy and fidelity; "the sunflower turns to her god when he rests the same look that she gave when he rose." The French, *Elle vous suit partout*, is epigrammatic; gira sol and perhaps heliotrope are analogous.

The inquisitive will likewise find their studies advanced by a knowledge of synonyms; how well does the French grenadier recall as it suggests the hand grenade, thrown by the then grenadier soldier. In vain did Dr. Black try to explain to Parisian savants that oxygen was procurable from plomb-rouge, but minium being proposed all became understood. Finally, it is useful to know that our cubeb is the French *poivre a queue*, tailed pepper.

Those who pay court to Mnemosyne find their reward in the facility with which much direct and collateral information is recalled to mind, sometimes even by a trivial idea; but from quite a scientific aspect it is of philological interest to know that most words indicative of red commence with *r*; thus red rose, rouge, rufus, rubicund, ruddy, rubefacient, rubia, rubus, rust, rubigo, ruby, robin, raddle, rhodium, rubidium, rutile, rhododendron and (though only by implication) robust, rustic and even roborans.—*E. Lloyd Marks, in the Australasian Jour. of Phar.*

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## MUSIC AND LONGEVITY.*

By EPHRAIM CUTTER, M.D., LL.D.

I SHALL try to show that music prolongs or is thought to prolong life; that diseases peculiar to and preventive of longevity chiefly are those that impede the circulation of air, blood, and nerve force; that music is physiologically capable of enlarging the chest, the capillaries, and of calming and regulating, if not increasing, nerve force; and that, other things being equal, longevity should belong to musical people.

### MUSIC PROLONGS LIFE.

In good old colony times there lived in the part of Massachusetts now called Maine a prosperous farmer, musician, and poet of the name of Maxim. At one time his mind was crazed by being crossed in love. Rope in hand, he sought a deserted log cabin located in a lonely open place, in order to hang himself over a beam. Just as he was entering the fatal building, a lone sparrow on the roof attracted his attention, and he became so much interested in its song that he pulled paper and pencil from his pocket and composed the following verse:

" As on some lonely building's top
The sparrow tells her moan,
Far from the tents of joy and hope
I sit and grieve alone."

He then and there also composed the music which exists under the name of Hallowell, and is found in Ditson's "Old Folks' Music," Boston, 1857, page 68, which is a fine minor fugue of the Holden style and time, and which is good enough for the Musical Society. After this poetical and musical effort, Mr. Maxim felt as if he would like the choir he led to sing the composition the next Sabbath. This could not be if he suicided, and the suicide was indefinitely postponed! So far as known, he lived to a good old age. Surely music in this case was a means of longevity! The authority for this story is

### MR. LUTHER WHITING MASON, OF BOSTON,

whose unbald head, eyes needing no glasses, intense musical activity for fifty years, and whose success in America, Europe, and Asia make of him a distinguished sample of longevity and music. His books are used by the million copies, and his pedagogic system has lately been adopted in Germany and indorsed by Reineke and others.

Dr. Benjamin Rush relates how an insane man was restored by hearing outside of a church a hymn sung which was the favorite of his mother, long since dead.

As if to bring such cases to date, there was one reported recently in New York papers of an insane widow being prevented by her oldest son of sixteen years from murdering her younger children in his absence by the promise of playing to her on an accordion when he should return at night. She was so fond of this music that she would quiet down at once and relinquish her murderous designs. This came out on her being taken in charge by the authorities.

### MUSIC THOUGHT TO PROLONG LIFE.

There is an old song, very popular in my boyhood, the burden of which was the shortness of the lives of certain artisans, "because they could not sing." It runs as follows, and, as it must be new to some of you, I will sing it, if you please:

"1. In good old colony times,
When we were under the king,
Three roguish chaps fell into mishaps
Because they could not sing.

"2. Now the first he was a miller,
And the second he was a weaver,
And the third he was a little tailor—
Three roguish chaps together.

"3. Now the miller he stole corn,
And the weaver he stole yarn,
And the little tailor stole broadcloth for
To keep these three rogues warm.

"4. But the miller got drowned in his dam!
And the weaver got hung in his yarn!
While the sheriff clapped his claw on the little tailor,
With the broadcloth under his arm."

Had not the public indorsed the sentiments of this song, it could not have been so popular, and I think we must conclude that our good ancestors regarded singing more compatible with long life than stealing, which in those days was a capital offense, I believe.

### PERSONAL INSTANCE.

The speaker has a wife who was his piano teacher before marriage. The truth is, that his digits are so short, and he made such poor progress, that he concluded it would be better to marry the teacher and thus have a good player through life than to undertake to learn himself. Never was he wiser! His wife says that during her courtship she was told he would not live to be thirty years old! She has taken so good care of him that he has lived to twice that age! Good music has been a great element in that care. The speaker thinks that if a man wants to prolong life, he should marry a good musical wife.

* An after-dinner speech to the Clef Club, of New York, May 22, 1893.

### A REMARKABLE INSTANCE OF MUSIC AND LONGEVITY.

The Rev. Peter Kimball died at Perth Amboy, June 15, 1892, aged ninety-nine years three months and twelve days. In a letter to the speaker, dated Perth Amboy January 14, 1892 (which is so remarkable for its chirography and vigor of thought that I pass it around for inspection), among other things he writes: "Now a word on my partial restoratives for heart and lungs. Flute and fife for lungs; drumsticks for heart. The right use of flute has restored the lungs of more than one or two, yet it needs care to avoid all undue use. All that hurts. So in the use of drumsticks, I truly believe their use has given me ten or twenty years. In November, 1890, I was so far gone that I thought nothing could help me. But I tried the drumsticks a little and soon found a marked gain, and so kept on doing and gaining, and for the past six months I have had no severe paroxysm." In another letter of March 5, 1892, he writes: "I read and write by native sight; taste food and enjoy apples as a boy. Recall events of 1797, 1798, 1799, and of 1882, 1883, 1884, and 1886 with equal ease. All this, though an invalid in July, 1859, by a terrible lesion of the heart, beating so loud that I could hear its thuds, and by a little undue effort I was unable to speak or do anything. In August, 1866, my face was ruddy and my step elastic and quick. I was the son of a farmer, eldest of twelve children; mother died of phthisis. Quit rum at seventeen years of age. No tobacco a day. Quit tea and coffee as destroyers of vitality, 1830. . . . I am small, five and one-half feet in height, weigh 125 pounds at my best. . . . Long life is good if used in works to please and honor God, and to regain His image so badly marred by sin. . . . I am free from the aches, troubles, and pains of old men; can solve questions in cube root, and give reasons for every step in the process. One swallow does not make a summer. True; but, if one comes, others may come. So other men doing as I have done may live much longer. . . ."

I visited him about a year ago. I found his heart, which had beat for nearly one hundred years, enlarged and valvularly diseased. His chest was well developed. He had a good head of hair. He was very entertaining and a good conversationalist. He played me a lively air on the flute. He also drummed with regulation drumsticks and with vigor on a bag of sand, while I sang Hail, Columbia! But I did not sing it fast enough to suit him, so he hummed a Napoleonic march and drummed away merrily.

When it is remembered that he had drummed and fifed ever since 1809, it must be conceded that he was a kind of musician long enough to give inferences upon which we can count. Certainly he was an example of music and longevity! Let us now pass to the

### DISEASES PECULIAR TO AND PREVENTIVE OF OLD AGE.

These may be classed as those which impede the circulation of air, blood, and nerve force. They are so numerous that we must select. Please take the Rev. Peter Kimball's dictum that music is a benefit to the lungs and heart.

Most of our race die of diseases of the chest before the time of old age comes. Consumption in its varied forms prevents old age more than any other disease. Lung fever, pneumonia, or, more correctly, pneumonitis, is a great foe to longevity.

Fatty degeneration, or where muscular, nervous, and glandular tissues are changed into and replaced by fat in any of its varied forms, is peculiarly a disease of old age, and when the young die from or have the diseases of fatty degeneration, they are prematurely old. Fatty heart and angina pectoris are examples; also Bright's disease of the lungs and kidneys; softening of the brain, with the complaints that masquerade as paralysis, paresis, palsy, apoplexy, aphasia, loss of mind and in some cases locomotion. Now, other things being equal, fatty degeneration is due to a retarded and impeded circulation ("Micrographic Dictionary"), or, in other words, to a sluggish flow of blood through the capillaries. The gorgeous beauty of autumnal foliage in New England is probably due to a fatty degeneration from a like cause. I have observed fat in the substance of the beautiful tinted maple leaf, along with a peripheral deposit in the ducts of the stem which more than half obliterated their caliber. Thus the degeneration of the leaf must have been due to the retarded and impeded circulation.

I have found fatty degeneration in apples when they had been compressed into facets by the barrel head pressure, which must have interfered with the interstitial circulation of the apple and made it sluggish.

A great cause of the impeded or sluggish circulation in man is due to the paralyzing effects of gases, generated in large excess and long operation in the alimentary canal, not alone on the adjacent but distant parts of the body. These gases are mostly derived from starchy and sugary food in too great proportion and use. It so happens that society ethics select such foods as the best, because they are sweet, pleasant, and palatable. In other words, table customs exalt the love of the beautiful in taste, and allow them to dominate all the other tests of food. This is said as history, not as complaint. In our way of thinking, the easiest and simplest way to help this fatty degeneration is to stop the excess of fermenting food, which has caused the impeded and sluggish circulation. But it is a curious ethical fact that people will cheerfully submit to amputations when they will not cut off any foods which they like. To be sure, Count Rumford, who was a great cook and scientific man, took, and the French, noted for cookery, take the same view. So, since it is almost impossible to get all people to deny themselves as to eating, it behooves us to use the best substitutes for relieving the impeded and sluggish circulation that we can find, and music is one such means, physiologically capable of expanding the capillary blood vessels and of calming, regulating, if not increasing, nerve force. The public even is coming to know that music acts reflexly on the nerves of the capillaries in which the functions of nutrition and secretion are performed, and which nerves expand or contract the capillaries according as they are acted on.

For example, when, under the influence of cold, the capillaries contract, music can expand them.

We know, without saying, that vocal music expands the chest easily and pleasantly, and thus at once an

increased circulation of air is secured for the system. But a Russian physiologist, Prof. Dogiel, of Kazan, whose monograph I have lately received through the politeness of Minister White, has made the most important discovery that man and animals have a decided rise of the blood pressure in the capillaries under the influence of music. The capillaries are expanded, the blood flows more freely, nutrition and heat are increased. The heart's action is also increased agreeably. Of course, to do this the nerve force also must be increased.

This may explain why the drumsticks gave our aged clergyman relief when the heart was laboring and disturbed. It indicates also that music is a medicine for diseases of fatty degeneration, because it removes the causal, impeded and sluggish circulation. It seems also right to infer that those who hear or perform music of the proper kind (for bad music is capable of producing very bad effects on the nervous system, as shown by the distress which young Mozart was once thrown into by the sudden and unexpected performance of what was called music from some uncouth instrument) will promote longevity, simply because it is less work to run the system. Athletes claim that their exercises promote the circulation. No doubt; but athleticism in the strictest sense requires such an expenditure of vital force or dynamics that it over-develops muscles at the expense of other organs—brain, for example. Sudden and premature deaths are common, and athletes are notoriously short-lived. Life is a question of expenditure of nerve force. If this is lavishly and uselessly used or expended on one system, the muscular, for example, the other systems suffer, and life will cease sooner from this waste of force. But music makes nerve force, and saves it also by making the system run more smoothly; hence, other things being equal, music is as important in our colleges as athletic training, if longevity is what is required. To be sure, in the words of the old song, "We must have air and exercise to live and thrive and grow." But music is a charming exercise, which can be used long after athletics have ceased to excite any interest. Old people enjoy music when they could not engage in athletics. For example, Mrs. Mary Monroe, of Morrisania, N. Y., was ninety-eight years old last February, when she received the guests who honored her birthday reception until midnight! We must admit this was a considerable feat of endurance for one so old. Still her soul goes out to music. Within a year she was in the habit of attending church and partaking of the communion. I met her there and she said, "I like to go to church because I love to hear the music."

Mrs. Rebecca Whittemore, my maternal grandmother, died at the age of ninety-seven years and eight months. Save deafness, her faculties were clear and good. She personally entertained and received guests; presided at her table, pouring out tea and coffee daily until three days of her death. She was extremely fond of violin music. Never have I seen a person express more pleasure than she did a year or two before her death, when her great-grandson, Mr. B. Cutter, a professional violinist, performed the music of her youth.

My great aunt, Mrs. Harriet Foster, of Manchester, N. H., at the age of eighty-four played the piano and sang songs to me. She found her music a great solace in her old age. And well it might, since we have learned how it expands the capillaries, makes the blood flow more freely, and thus retards the fatty degeneration of decline.

MUSIC AND CONSUMPTION.

There is not time to give the details of cases where people supposed and pronounced to be in consumption have recovered under vocal culture in speech and song, and playing wind instruments. As a general rule, the expansion of the lungs prevents the development of tubercle. The view I take of consumption is that it comes through the food fermenting in the alimentary canal in which the bacillus of the vinegar yeast is developed.

If, for certain reasons which are not well understood, the disease can be kept there, chronic diarrhœa or consumption of the bowels follows. But if the vinegar yeast escapes into the blood it is quite sure to be arrested in the capillaries of the lungs, especially when contracted by the influence of cold on the surface of the body. The lung tissues are very elastic and spongy and contractile. The fact that vinegar yeast may be found in the blood of a consumptive generally for the space of one year before the lungs break down gives time for the victim to escape if the lungs are kept fully expanded so that the circulation is not impeded, and tubercle has no chance to form because the bacilli are not caught, engaged, or held in the capillaries. Now if such patients could have gentle vocal musical culture, which expands the lungs, they stand a good chance to escape the development of tubercle. Again, even when deposited, tubercle may and has been rendered harmless by the use of wind instruments and vocal culture. There are cases to prove this, and music certainly here is a means of longevity. Should this idea become generally known and adopted, our conservatories and teachers will find a fine field of medical effort in departments specially adapted to those threatened with consumption.

The American *materia medica* has already included music as a medicine. In London a guild has been formed for this purpose called the St. Cecilia's, whereby music is furnished to hospitals and individuals. I have seen, as you have, probably, the marvelous reports as to the efficacy of music in surgery and so on. I have not been able to verify these, but hope, through English correspondents, to know just what has been done.

BRONCHITIS AND PNEUMONIA.

In these complaints there is always a congestion of the capillaries. I can conceive how any one who feels the first signs of chill and constriction in the chest might abort the beginnings of these complaints by vocal music. I have myself, when I felt chilled along with constriction in chest, by expanding the lungs with song or holding the breath, had the extremities become warm, the bad feelings removed, and no bronchitis or pneumonia followed.

I have known cramp of the legs to be arrested by a song, and severe disturbance of the bowels dissipated by music.

I do not wish to press this matter too far, nor to claim that music alone will produce longevity. Life is a warp and woof of many causes, but I do believe that if musical people would live rightly as to food, clothing, exercise, and temperance, they would have more longevity than now. Carl Formes, the basso, has died at an advanced age in California within two years. Up to that time he was in the full exercise of his teaching powers the livelong day.

LONGEVITY OF MUSIC.

This subject would not be complete without some reference to the facts in sacred history, that "the morning stars sung together, and all the sons of God shouted for joy" at the creation; that 6,000 years ago Jubal was "the father of all such as handle the harp and organ," and people of those days lived to 800 and 969 years; that about 3,300 years ago Moses and the children of Israel sang—Moses, who lived to be 120 years old, the greatest law giver and judge. He shows that the highest judicial qualifications did not prevent him from being a singer and poet. That David, the slayer, with his hands, of a lion and a bear, and with his sling, of the giant Goliath—David the king, the greatest poet, harper, and musician of the best class; that Jesus Christ sang; that music is in Heaven, the dwelling place of the immortal blessed, who, in the words of Payson, "Pour forth songs of praise as unceasing as the displays of those glories which excite them; or, in words of Dr. Beaumont, "Heaven is a sanctuary . . . where hymns of praise, hallelujahs of salvation and hosannas of redemption, uttered by blessed voices without number, ever sound before the throne."

These allusions are made as some of you are directors of sacred music, and I would like you to feel that your part is of equal import and longer lived than any other of the exercises of worship. Some of our church music is taken from the tabernacle service before Solomon's time. For example, the music to "O! Sacred Head Now Wounded." Again, I have heard sung the music that Miriam sang with her brother Moses at the crossing of the Red Sea, and the lamentations of Jeremiah sung as they were first written, as was assured by good authority. Sacred music is the mother of all other music. Besides, we have seen, it is to last through eternity. It is with peculiar honor, significance, and propriety that a musical director was lately ordained in a Congregationalist church in Hartford, Conn. It was a fit recognition of the divine longevity of music.

To conclude, so long as music is so closely connected with longevity, objectively and subjectively, musical directors should magnify their high calling and see to it that but the best is offered in sacred worship. Lame and sick music—"Offer it now to thy governor. Will he be pleased with thee or accept thy person?" Remember that good music in public worship not only brings nearer to God, but, by improving the circulation of nerve force, air, and blood, directly promotes longevity, has cured insanity, and increased the sum of human happiness on earth, and is found in heaven.

## ON POISONING FROM CANNED FISH.

By Dr. A. B. GRIFFITHS, F.R.S. Edin., etc.

THE poisonous ptomaines, formed from albuminoids during the decomposition of food, produce symptoms of poisoning, etc., which are said to be referable to the digestive and nervous systems. These symptoms manifest themselves at periods varying from a few hours to several days after eating food. The symptoms produced by this class of ptomaines are the following, among others: Unpleasant taste in the mouth, headache, vomiting, diarrhœa, salivation, dyspnœa, paralysis, and death. Several ptomaines render the heart's beats slow and weak, and in some cases of poisoning by unwholesome fish, the symptoms resemble those of poisoning by atropine.

Poisoning by unwholesome foods too frequently escapes notice; nevertheless every analyst or medical man who is careful of his scientific dignity should possess a thorough knowledge of the properties of the ptomaines, which have now quite a literature of their own.

Numerous deaths have occurred in England (see Griffiths in *Chemical News*, vol. lxii., p. 17; and the reports in *Daily Graphic*, November 25, 1892; *Daily News*, November 22, 1892, and April 22, 1893), on the Continent and in America, from eating unwholesome foods; and it has been shown that the poisonous properties of such foods are due to the action of microbes on the proteids contained in the foods. It may be stated that these poisonous properties are due to certain ptomaines or animal alkaloids. The ptomaines are produced during the putrefaction or decomposition of animal substances. By the direct action of microbes, the proteids are disintegrated, with the formation of ptomaines among other products. It will be seen, from this remark, that the ptomaines are not secreted or excreted by microbes, for they are the *residua* after microbian action. To explain the action of microbes on organic matter generally: Let $a_3b_4c_6d_3$ represent the composition of the medium in which certain microbes live, and let $a_2b_2c_3d_1$ represent the food extracted from such a medium by the microbes for their nourishment; it therefore follows that $a_1b_2c_3d_2$ will represent the residue or the products of the microbian action—be it fermentation, nitrification, the production of ptomaines, etc.

It should also be borne in mind that the idea of ptomaines *without* microbes is inconsistent with an impartial study of facts. It is true that a suitable filtration (*e. g.*, through porous porcelain) will separate a ptomaine from its microbe; but when this microbe is separated from the original liquid and transferred successively to nourishing media, so as to purify it from every foreign element, it continues to produce its characteristic ptomaine (or ptomaines), which is produced at the expense of the culture fluid. There is no true ptomaine without microbes, any more than there is ergotine without *Claviceps purpurea*, vinegar without *Bacterium aceti*, or alcohol without certain species of the *Saccharomycetes*.

Such are our preliminary remarks concerning the ptomaines; we now proceed to describe a new ptomaine which we have extracted, from *putrid sardines*, by the following process:

The putrid mass was boiled with water, filtered, and the filtrate precipitated with subacetate of lead. This precipitate was filtered off, a current of $H_2S$ passed through the filtrate, and the plumbic sulphide separated by filtration. The filtrate was concentrated by evaporation and then extracted with amylic alcohol. The amylic solution was repeatedly treated with water, then concentrated, acidulated with $H_2SO_4$, and repeatedly shaken with ether, which removes the oxy-aromatic acids. Freed from ether, it was evaporated to a quarter of its volume, and thus volatile fatty acids were driven off. The $H_2SO_4$ was precipitated by baryta, and the precipitate removed by filtration. The excess of baryta was precipitated by a current of $CO_2$, and this was also removed by filtration. The fluid was heated for some time on a water bath, cooled, and precipitated with $HgCl_2$. The precipitate was washed and decomposed by $H_2S$; the mercuric sulphide was filtered off, and the filtrate concentrated. The hydrochloride of the ptomaine was subsequently deposited in the crystalline condition. It was dissolved in water, and then treated with pure calcium hydroxide, which liberated the base. The ptomaine was separated by chloroform, in which it is soluble; and it was finally purified by washing with alcohol and water.

This new ptomaine is a white crystalline substance, soluble in water, and has a slight alkaline reaction. It is precipitated by hydrochloric acid in the form of a white crystalline hydrochloride. Platinic and auric chlorides precipitate this ptomaine, and the resulting platino-chloride and aurochloride are yellow crystalline compounds. This base produces with phosphomolybdic acid a greenish precipitate, with phosphotungstic acid a yellowish white precipitate, and with picric acid a yellow one. It is also precipitated by silver nitrate and Nessler's reagent. Analyses of this base gave the following results:

0·378 gramme of substance gave 0·9660 gramme of $CO_2$ and 0·2034 gramme of $H_2O$.

0·2213 gramme of substance gave 14·1 c. c. of N.

| | Found. I. | Found. II. | Calculated for $C_{11}H_{11}NO_2$ |
|---|---|---|---|
| Carbon | 69·77 | — | 69·84 |
| Hydrogen | 5·98 | — | 5·82 |
| Nitrogen | — | 7·45 | 7·40 |
| Oxygen | — | — | 16·94 |

The above figures correspond with the formula:

$$C_{11}H_{11}NO_2$$

for this new ptomaine.

This base, which has been named *sardinine*, is poisonous—producing vomiting, diarrhœa, and death; and there is little doubt that it is the cause of the poisoning which results from eating putrid sardines or sardines which have been badly tinned.

It may be useful to give a list of the ptomaines which have been extracted from the products of bacterial putrefaction of certain fishes, etc.:

(1.) Parvoline, $C_9H_{13}N$, from mackerel (Gautier and Etard).
(2.) Hydrocollidine, $C_8H_{13}N$, from mackerel (Gautier and Etard).
(3.) Scombrine, $C_{17}H_{38}N_4$, from mackerel (Gautier and Etard).
(4.) Muscarine, $C_5H_{13}NO_2$ (Brieger).
*(5.) Gadinine, $C_7H_{16}NO_2$, from cod (Brieger).
(6.) Ethylenediamine, $C_2H_8O_2$, from cod (Brieger).
(7.) Mytilotoxine, $C_6H_{15}NO_2$, from mussels (Brieger).
(8.) Sardinine, $C_{11}H_{11}NO_2$, from sardines (Griffiths).
(9.) Collidine, $C_8H_{11}N$, from cuttle fish (De Coninck).
(10.) Coridine, $C_{10}H_{15}N$, from cuttle fish (De Coninck).

In addition to "fish poisons," it may be mentioned, *en passant*, that Lewis (*Chemical News*, vol. lxvii., p. 52) believes that the twenty cases of poisoning in America, which resulted from eating tinned beef (in 1892), were due to neuridine ($C_5H_{14}N_2$); and the poisoning which sometimes results from eating unwholesome cheese, ice cream, etc., has been proved to be due to a ptomaine which is named tyrotoxicon ($C_6H_5N_2$) by Vaughan.†

In conclusion, there is no doubt that the ptomaines play an important part in most cases of poisoning from eating unwholesome food, and it is of primary importance that analysts, medical men, and others should make themselves thoroughly familiar with the properties of these curious products of putrefaction.

## ELECTRICAL AND LIGHT VIBRATIONS.

AT a recent meeting of the Physical Society, Berlin, Prof. Von Helmholtz, president, in the chair, Dr. Rubens gave an account of experiments he had made, together with Dr. Du Bois, on the permeability of metallic wire gratings to polarized heat rays. As is well known, Hertz's experiments on electric oscillations brought them into close relationship to the properties of light vibrations, as shown by reflection, refraction, and polarization. The fact that metallic gratings act as polarizers toward electric waves, inasmuch as the waves can only pass through when the wires of the grating are parallel to them, has no analogue in the case of light, since linearly polarized light can pass through a grating whatever be its position. On the assumption that this difference is dependent simply on the fact that light waves are too small for the gratings employed, the authors had experimented with the longer heat rays and gratings of extremely narrow aperture. The latter were made of the finest wire (gold, silver, copper, and iron), the intervals between the wires being 0·0025 mm., and the rays of a zirconium flame, up to W. L. 6$\mu$, were examined. The ocular of the spectroscope carried a very sensitive bolometer. It was found that with each of the gratings the ultra-red rays behaved like electric waves; those rays which vibrated at right angles to the plane of polarization passed through a grating placed parallel to their plane, in threefold extent, as compared to the amount which passed when the grating was at right angles. This result was obtained with different metals with varying wave lengths of the rays, *e. g.*, with silver by W. L. above 2$\mu$.

* Gadinine is non-poisonous.

† For further details concerning the ptomaines, see Griffiths' "Researches on Micro-Organisms" (Bailliere) and "Manual of Bacteriology" (Heinemann); and the case of poisoning from eating ice cream, reported in Birmingham *Daily Post*, September 22, 1892.

## CANADA AT THE WORLD'S COLUMBIAN EXPOSITION.

CANADA occupies a very prominent position in the Manufactures and Liberal Arts building, its series of courts on the main floor alone covering an area of 117 × 134 feet.

A distinctively Dominion court is its fine fisheries exhibit in the Fisheries building, to which the Department of Marine and Fisheries, as well as several individual exhibitors, have contributed, with the result that the large court stands out prominently and attracts much notice.

Ontario exhibits about 2,000 samples of grain in bottles and as many in the straw.

This collection contains 330 samples of wheat in straw, as many of oats, 100 of barley and numbers of peas, beans, buckwheat, flax, grass, millet, rye, corn and timothy—all in the straw. Of samples of grain there are 426 of wheat, 300 of oats and 168 of peas and other grains in proportion.

The celebrated big cheese was made at the Dominion Experimental Station in Perth, County of Lanark, and is the work of Mr. J. A. Ruddick, of that town. It forms one of the attractions of the Agricultural building, its weight of 11 tons, its height of 6 feet and its circumference of 28 feet being figures quite as imposing as its value of $5,000, and the fact that 10,000 cows contributed one day's milking to its enormous bulk, 12 large cheese factories in Ontario supplying the curds to make it.

The Dominion has once more established its reputation as one of the leading cheese countries of the world by carrying off over 90 per cent. of the awards. The total number of single exhibits of cheese was 667. Of these Canada sent 162, and of the total number of some 135 exhibits which won medals in the factory classes, no less than 126 were from Canada.

Ontario is also represented in the honey exhibit, and is the only foreign exhibitor in competition with several States. It is evident Ontario excels in comb honey, while the extracted honey exhibited shows a superior clearness and coloring. Quite a curiosity in its way is a solid block of 50 lb. of candied thistle honey shown on a silvered glass platter, and one of the same weight, but covered with a bell jar, of clover honey. The extracted linden honey is of a lovely light amber hue. Among the beeswax is a chunk weighing 50 lb. Some of the candied honey is as white as the driven snow.

In the Mines building the Ontario exhibit contains as its chief ornament a massive lump of nickel ore, weighing 12,000 pounds, surrounded by smaller pieces. These form the largest and most complete showing of nickel ore at the Fair, most of the specimens being from the mines of the Canadian Copper Company. There is also a large ingot of pure nickel, weighing 2¼ tons, valued at $2,250.

Marbles and granites beautifully polished, the latter equal, in the opinion of experts, to the best Scotch, occupy a prominent position in the front of the court, and those interested in lithography find a quality of stone for that purpose that has no superior.

A fine front in green and gold is made most imposing by a beautiful Corinthian arch, in which are two granite columns from the Kingston quarries of the Canadian Granite Company, who also contribute a pink granite one from South Bay, Lake Nipissing. *The Dominion Illustrated* gives the foregoing particulars. We are indebted to the *Illustrirte Zeitung* for our engraving.


THE WORLD'S COLUMBIAN EXPOSITION—THE EXHIBIT OF ONTARIO.

## GERMAN NOTES FROM THE CHICAGO EXPOSITION.

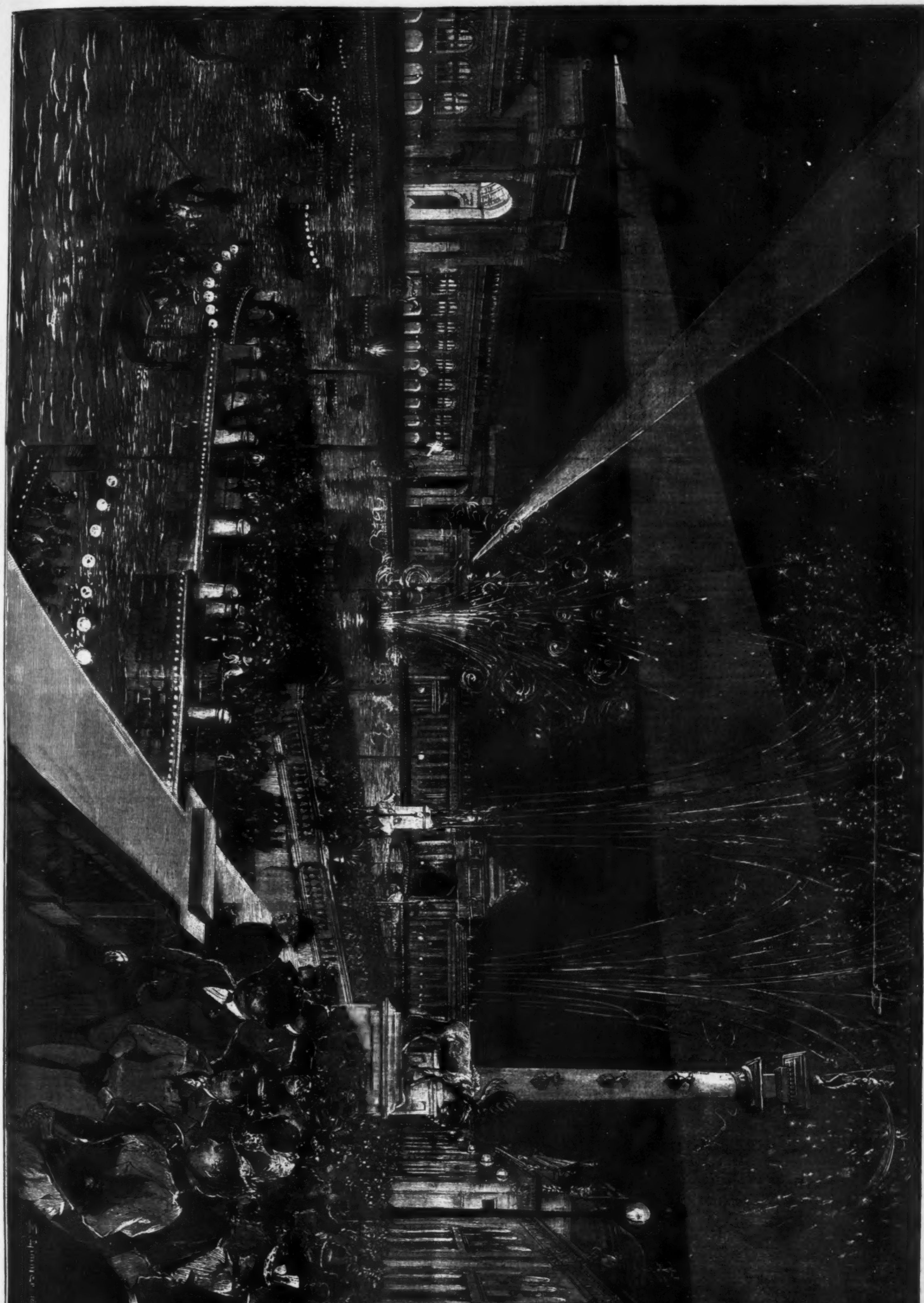
THE following description of the celebration of the Fourth of July is from the *Illustrirte Zeitung*, of Leipzig:

"The Fourth of July is the greatest national holiday of the United States of America, the memorial day of the declaration of independence, and Independence Day, as a rule, is celebrated in a very noisy manner in all sections of Uncle Sam's large domains. The American colonies abroad also gather on this day for banquets, and at the sound of the goblets they drink to liberty, George Washington, the republic, and many other objects and persons. In America itself illuminations, fireworks, bonfires and the like form the most important item of the programme of this day, and the youngsters have a jolly time heaping up and setting on fire old barrels, boxes and other combustible materials, or firing off crackers, which, jumping along in the street, often get between the legs of an unsuspecting passer-by and have been the cause of innumerable accidents.

"Independence Day furnished to the managers of the Chicago Exposition an opportunity of displaying before the eyes of the visitors of Jackson Park an illumination of a fairy splendor such as had never been witnessed in America. When walking in the evening on the magnificent Columbia Square or on the avenues which radiate from it and are adorned with gigantic palaces, one should imagine one's self carried from the extreme Occident into the dreamland of Orient. This effect is produced partly by the picturesque array of the Exposition buildings with their imposing facades, the splendid white peristyles, the numerous monuments, cupolas, towers, pavilions, the large ponds and canals, but principally by the arrangement and distribution of enormous beams of light which are located so as to produce surprising effects. Half a hundred of powerful steam engines, with an aggregate capacity of 25,000 horse power, are placed in the Machinery Hall to operate the dynamos; these mysterious apparatus work steadily and almost noiselessly and furnish to the conducting wires a quantity of electricity sufficient to produce light of about 3,000,000 candle power, as if it were contemplated to equal the glorious splendor of the sun. Never have so immense quantities of light been profusely spread over a space of comparatively small extent! The Jupiter at the switchboard, the engineer on duty, sends his flashes of lightning on the Exposition grounds and produces a daylight illumination of the interior of all the palaces and pavilions. Nearly 150,000 lamps are lighted at one time—about three times the number of street lanterns the entire city of Paris possesses—and it is almost impossible to realize the magic effects which are attained by this profusion of light. On the evening of Independence Day the illumination was more beautiful than any description can convey. As soon as darkness had begun, flashes of light crept along the immense palaces and displayed their contours in fiery lines; they flashed along the railings of the ponds and Venetian canals, the peristyles, the domes, and formed brilliant diadems on the entrances to the buildings and the pavilions; thousands of incandescent lamps contributing to this result. Most of the colossal facades of the palaces were profusely illuminated, and powerful beams of light streamed out of the large windows. The Palace of Liberal Arts contains 10,000 lamps; the Administration building, 5,000; the Agricultural building, 4,000; the Machinery Hall and the Palace of Mines and Mining each 3,000 lamps. Groups of luminous jets of water rise from the numerous fountains, are resolved into drops and fall back into the step basins like sparkling diamonds; intense search lights caused the waters rushing into the main basin to appear like liquid luminous silver, and the two monumental fountains at the sides of the Columbia fountain sent jets of various colors high up into the air.

"Search lights of a hitherto unknown power, among them some of a quarter million candle power, were located on the roofs of various palaces and turned in succession on the several buildings, statues or monuments. The facades and domes seemed to be luminous themselves under the influence of this intense light, as if they had been constructed of phosphorus. When the search lights were directed upward upon the clouds, the effect was a startling one; the round image of the reflector appeared in the clouds as in a mirror and produced the impression of a gigantic moon descending suddenly from the zenith, like an enormous meteor, upon the crowds numbering hundreds of thousands of people; and again it glided along the clouds, chang-

THE WORLD'S COLUMBIAN EXPOSITION—EVENING OF INDEPENDENCE DAY.



THE WORLD'S COLUMBIAN EXPOSITION—EVENING OF INDEPENDENCE DAY.

ing its shape in a fantastic manner, and the beam of light appeared like the tail of an immense comet formed of luminous vapors.

"On the basins and the canals there was a moving multitude of electric launches and Venetian gondolas, covered with variously colored lanterns which, however, were almost eclipsed by the profusion of light with which the atmosphere was saturated; in the background, where the dark surface of Lake Michigan was visible in the night, there was a flash from time to time, and hundreds of rockets, fireworks of all kinds, sheets and jets of fire of manifold colors, went up into the air, almost touching the clouds. While the astonished crowds were witnessing this display of light, a small number of workmen were busy in the subways, or as it were the catacombs of the Exposition, handled the levers on the switch boards, and thus easily produced these grand effects of light. A slight pressure with the finger on the central switchboard would have sufficed to plunge the entire scene into darkness, thus affording a proof of the control the human mind has obtained of the forces of nature."—*E. Von Hesse-Wartegg, in Illustrirte Zeitung.*

## THEORIES OF THE ORIGIN OF MOUNTAIN RANGES.*

By Prof. JOSEPH LE CONTE, the retiring President.

MOUNTAINS are the focal points of geological interest. In their complex structure are contained all kinds of rocks—sedimentary, eruptive and metamorphic; and in their formation are engaged all geological forces in their greatest intensity. They are the culminating points, the theaters of greatest activity of all geological agencies, igneous agencies in their formation, aqueous agencies by sedimentation in their preparation, and by erosion in their subsequent sculpture. Their discussion, therefore, is a summation of all the principles of structural and dynamical geology. But they are equally important in historical geology; for the birth of mountains marks the times of great revolutions in the history of the earth, and therefore determines the primary divisions of geological time. Evidently, therefore, the theory of mountains lies at the very basis of theoretic geology, and a true theory must throw abundant light on many of the most difficult problems of our science.

But if this is the most important, it is also the most difficult of all geological questions. My object now is to give, as briefly as possible, the present condition of science on this subject. But in all complex subjects there is a region of comparative certainty and a region of uncertainty, a region of light and a region of twilight. My farther object, therefore, will be to separate sharply these two regions from one another, and thus to clear the ground, narrow the field of discussion and direct the course of profitable investigation.

But first of all I must define my subject. A mountain range is a single *mountain individual*, born at one time (monogenetic), *i. e.*, the result of one—though it may be a prolonged—earth effort; as contra-distinguished on the one hand from a mountain system, which is a family of mountain ranges born at different times (polygenetic) in the same general region, and on the other hand from ridges and peaks, which are subordinate parts—limbs and organs—of such a mountain individual. Now, a theory of mountains is essentially a theory of mountain ranges, as thus defined. In all that follows, therefore, on the subject of mountain structure and origin, we refer to mountain ranges.

### STRUCTURE OF MOUNTAINS.

The origin of mountains must be revealed in their structure. We must, therefore, give briefly those fundamental points of structure on which every true theory of origin must be founded.

1. *Thickness of Mountain Sediments.*—The enormous thickness of mountain strata is well known, but it is impossible to overstate its fundamental importance. We therefore give some striking examples. The Palæozoic rocks involved in the folded structure of the Appalachian, according to Hall, are about 40,000 ft. thick. The Palæozoics and Mesozoics in the Wahsatch, according to King, are about 50,000 ft. thick. The Cretaceous alone, in the Coast Range of California near the Bay of San Francisco, according to Whitney, are 20,000, and in Shasta County, according to Diller, are 30,000 ft. thick. The Mesozoics and Tertiaries of the Alps, according to Alpine geologists, are 50,000 ft. (Judd, Volcanoes, p. 295). The Upper Palæozoic and Mesozoic of the Uinta, according to Powell, are 30,000 ft. These are conspicuous examples, but the same is true of all mountains.

It might be objected that these numbers express the general thickness of the stratified crust everywhere, only that in mountains the strata are turned up and their thicknesses exposed by erosion. But this is not true. For in many cases the strata may be traced away from the mountain; and in such cases they always thin out as distance increases. For example, the 40,000 ft. of Appalachian Palæozoics thin out going west until at the Mississippi River they are only 2,000 to 4,000 ft. The Palæozoics which in the Wahsatch are 30,000 ft. thin out eastward until they are only 1,000 ft. on the plains. It follows then that *mountains are lines of exceptionally thick sediments.*

2. *Coarseness of Mountain Sediments.*—Mountains are composed mainly of grits, sandstones, and shales, *i. e.*, of mechanical sediments, and most conspicuously so along their axial regions. As we go from this region, sometimes in either direction, but especially in one direction, the strata become finer and finer; sandstones giving way to shales and shales to limestones, *i. e.*, mechanical to organic sediments. This is conspicuously true of the Appalachian; in so many ways a typical mountain. As we pass from the eastern ridge westward, grits and sandstones are replaced by shales, and these by limestones. Therefore, mountains are also *lines of exceptionally coarse sediments.*

3. *Folded Structure of Mountains.*—The folded structure of mountains is perhaps the most universal, and certainly the most significant of all their features. But there is great variety in the degree and complexion of the foldings. Sometimes the mountain rises as one great fold. The Uinta is an example of this. Sometimes and oftener there are *several open* folds, like waves of the sea. The Jura is a good example of this. Sometimes and oftenest of all, there are many closely *appressed* folds. This is the case in the Coast Range of California, in the Appalachian, in the Alps, and probably in the Sierra. The Appalachian may be taken again as the type. In this range the folds are most numerous and most closely appressed in the axial region, and open out and die away in gentle waves as we go westward. Finally, sometimes in extreme cases, as in the Alps, the Pyrenees, and probably the Sierra, the strata of the lateral slopes are thrust in under the central and higher parts, so that the strata of these central parts are overfolded outward on one or both sides. This is the *fan structure*, so marked in the Alps and Pyrenees, where the underthrust and overfold is on both sides, but found also in the Appalachian and Sierra, where they are on one side only.

*Amount of Folding.*—Folded structure implies, of course, an alternation of anticlines and synclines. The number of these varies with the intensity of the folding. In the Coast Range there are apparently four or five anticlines and corresponding synclines. In the Sierra they cannot be counted, but there must be very many so closely appressed that the strata seem to be a continuous series dipping all in the same direction, *i. e.*, steeply toward the axis, for at least 30 miles. They cannot form a single series, for this would make an incredible thickness. It must be a series repeated several times by extreme folding, how many it is impossible now to say. In the Appalachian, according to Claypole (*Am. Nat.*, vol. 19, p. 257 and seq.) there are about 19 anticlines and synclines in 65 miles, and in one part—Cumberland Valley—there are 8 in 16 miles. In the Vaudois Alps, according to Renevier, there are at least 7 (*Archives des Science*, vol. 59, p. 5, 1877), and in Savoy as many as 15 (*Archives*, vol. 28, p. 608, 1892, and 25, p. 271, 1893). In many cases the foldings are so extreme that the strata first rise as folds, then are pushed over beyond the base as overfolds, and finally broken at the crest and the upper limb pushed over the lower limb many miles horizontally. In the Highlands of Scotland, according to Peach, by overthrust the Archæan is brought over the Silurian and overrides it for ten miles. In the Rocky Mountains of Canada, according to McConnell, the Cambrian is brought over the Cretaceous and overrides it for seven miles. In the Appalachian of Georgia, according to Hayes, by overthrust the Cambrian is made to override the Carboniferous for eleven miles.

4. *Cleavage Structure.*—Closely connected with the last, and having a similar significance, viz., lateral squeezing and mashing, is another structure—*cleavage.* This structure is often associated with folding, and both with mountain ranges. It is not so universal as folding only because all kind of strata are not equally affected by it, being well exhibited only in fine shales. It is important to observe that in slaty cleavage the *strike* of the cleavage planes is the same as that of the strata, and both the same as the trend of the mountain; and that the *dip* of the cleavage planes is nearly or quite vertical. Whole mountains are thus cleavable from top to bottom.

5. *Granite or Metamorphic Axis.*—Some mountains are made up wholly of folded strata. This is the case in the Appalachian, the Coast Range and the Jura. But most great mountains consist of a granitic or metamorphic axis with stratified flanks. This is conspicuously the case with the Sierra, the Alps, and most other great mountains. So general is this, that the typical structure of ranges may be said to be a granitic axis forming the crest and stratified rocks, more or less folded, outcropping on the slopes. This very characteristic structure ought to be explained by a true theory of origin.

6. *Asymmetric Form.*—Mountains are not usually symmetric, with crest in the middle and slopes equal on the two sides. On the contrary, they usually have a long slope on one side and a steeper, often a very abrupt, slope on the other. The crest or axis is not in the middle, but nearer to one side. The earth wave seems ready to break and often does break with a great fault on the steeper side. The Uinta is perhaps the simplest example. This range rises as a single great fold, but steeper on the north side, where there is a fracture and fault of 20,000 ft. vertical. Of course in this as in all cases the original fault cliff has crumbled down to a steep slope, or even been destroyed entirely. The Sierra and Wahsatch are remarkable examples of asymmetry. The Sierra rises on the west side from the San Joaquin plains near sea level by a gentle slope 50 to 60 miles long, reaches its crest near 15,000 ft. high, and then plunges down by a slope so steep that the desert plains on the east, 4,000 to 5,000 ft. above S. L., is reached in 6 to 10 miles. There is on this side a fault cliff nearly 11,000 ft. high. The Wahsatch has a similar form, except that the fault cliff looks westward instead of eastward. It is true that the extreme asymmetry of these two mountains was given them long after their origin, and by a different process, presently to be described. But even before this last movement they were probably asymmetric, though in a less degree. The Appalachian is perhaps here again a typical mountain. Its long slope is to the west and its crest close to the eastern limit. The Alps, the Apennines, the Carpathians, and the Caucasus, according to Suess, are foreign examples of the same form.

There are many other interesting points of structure that might be mentioned, but they are less significant of mode of origin, and therefore omitted in this rapid sketch.

### ANOTHER TYPE OF MOUNTAINS.

I have given the main characteristics of mountains of the usual type, of which the Appalachian, the Coast Range, the Alps and Pyrenees may be taken as good examples. But there is another type, different in structure and in mode of origin, to which attention, I believe, was first called by Gilbert. It is doubtful if they are found anywhere except in the Basin and Plateau regions, and therefore the type may be called the Basin region type. The Basin and Plateau regions are broken by north and south fissures into great crust blocks, which, by gravitative readjustment, have been tilted, *i. e.*, one side heaved up and the other side dropped down, so as to form a series of north and south ridges and valleys. Each ridge rises by a long slope on one side to a crest and then drops by a steep fault cliff on the other. The ridges, therefore, are extremely asymmetric, but the asymmetry is produced in a different way from that of the usual type. In a word, these mountains seem to be the result of a series of enormous parallel faults. Such faults are common everywhere, but do not usually give rise to any inequalities which may be dignified by the term mountain; or if so at one time, have since been leveled by erosion. But those in the Basin region are on so grand a scale and so recent in time that they form very conspicuous orographic features. I have sometimes doubted whether they should be called ranges at all; but when we reflect that at least 10,000 ft. of the height of the Sierra is due to normal faulting, it seems impossible to withhold the term. Thus mountains may be divided into two types, viz., mountains formed by folding of strata and mountains formed by tilting of crust blocks. The structure of the one is anticlinal or *di*clinal, of the other *mono*clinal. The Sierra probably belongs to both types. It was formed at the end of the Jurassic as a mountain of the first type, but the whole Sierra block was tilted up on its eastern side without folding, at the end of the Tertiary, and it then became also a mountain of the second type.

A complete theory must explain this type also; but since from its exceptional character it must be regarded as of subordinate importance, we shall be compelled to confine our discussion to mountains of the usual type.

### EXPLANATION OF THE PRECEDING PHENOMENA.

In all cases of complex phenomena there have been many theories becoming successively more and more comprehensive. The citadel of truth is not usually taken at once by storm, but only by very gradual approaches. First comes the collection of carefully observed facts. But bare facts are not science. They are only the raw materials of science. Next comes the grouping of these facts by laws more or less general. This is the beginning of true science. Every such grouping or reducing to law is a scientific explanation, and therefore in some sense a theory. At first the grouping includes only a few facts. The explanation or theory lies so close to the facts as to be scarcely distinguishable from them. It is a mere corollary or necessary inference. It is modest, narrow, but also in the same proportion *certain.* Then the group of explained facts becomes wider and wider, the laws more and more general, and the theory more daring (but in the same proportion also perhaps more doubtful), until it may at last include the cosmos itself in its boundless but shadowy embrace.

Now in this gradual approach toward perfect knowledge there are two very distinct stages. The one consists of explanation of the immediate phenomena in hand. This gives the laws of the phenomena and may be called the *Formal Theory.* The other explains the cause of these laws, and may be called the *Causal or Physical Theory.* All science passes through these two stages. For example: Until Kepler, the phenomena of planetary motion were a mere chaotic mass of observed facts, without uniting law. Kepler reduced this chaos to order by the discovery of the three great laws which go by his name. T is is the *formal* theory of planetary motion. But still there remained the question, Why do planets move according to these beautiful laws? Newton explained this by the law of gravitation. This is the causal or *physical* theory.

But this is so important a distinction that I must illustrate by examples taken from geological science. All the phenomena of slaty cleavage are completely explained by supposing the whole rocky mass to have been mashed together horizontally and extended vertically. This is the formal theory, and may be regarded as certain. But still the question remains, How does mashing produce easy splitting in certain direction? The solution of this question is the physical theory, and is perhaps a little more doubtful, although I think satisfactorily answered by Tyndall. But still there remains a deeper and more doubtful question, Whence is derived the mashing force? Is it general interior contraction, as some think, or is it local expansion? as others think. A perfect theory must answer all these questions. Take another example: All the phenomena of the drift are well explained by the former existence of an ice sheet moving southward by laws of glacial motion, scoring, polishing, and depositing in its course. This is the Formal Theory. But still the question remains, What was the cause of the ice sheet? Was it due to northern elevation or to aphelion winter concurring with great eccentricity of the earth's orbit? And if due to northern elevation, what was the cause of that elevation? A perfect theory must answer all these questions. Take one more example: All the phenomena of earthquakes are completely explained by the emergence on the surface and a spreading there from a center of a series of elastic earth waves. This is the Formal theory. It explains the immediate facts observed here on the surface, but no more. But there still remains the question, What is the *cause*, deep down below, of the concussion which determined the series of earth waves? This, the physical theory, is far more doubtful. Or the theory may be made still deeper and wider and proportionately more doubtful. If our theory of the cause of the interior concussion be the formation of a fissure or readjustment of a fault, as seems in many cases probable, there would still remain the question of the cause of great fissures and of their subsequent readjustment by slipping. This is probably as far as geological theory would go; for, although cosmogony may go still farther, the interior heat of the earth is usually the final term of strictly geological theories.

I have made this long detour because I wish to keep clear in the mind these two stages of theorizing in the case of mountain origin. The formal theory is already well advanced toward a satisfactory condition; the physical theory is still in a very chaotic state. But these two kinds of theories have been often confounded with one another in the popular and even in the scientific mind, and the chaotic state of the latter has been carried over and credited to the former also; so that many seem to think that the whole subject of mountain origin is yet wholly in the air and without any solid foundation.

### I. FORMAL THEORY.

A true formal theory, keeping close to the imme-

* Annual address before the American Association for the Advancement of Science, at the Madison meeting, August, 1893.

diate facts in hand, must pass gradually from necessary inferences, from smaller groups to a wider theory which shall explain them all.

*Inferences from 1 and 2, i. e., Thickness and Coarseness of Sediments.*—The thickness of mountain sediments, as we have seen, is greatest along the axis and grows less as we pass away from that line. Now where do we find lines of very thick sediments forming at the present time? The answer is: On sea bottoms closely bordering continents. The whole washings of continents accumulate very abundantly along shore lines and thin out seaward. Mountains were, therefore, born of sea margin deposits. This view is entirely confirmed by the character of mountain sediments. We have seen that these are coarsest near the crest, becoming finer and then changing into limestones as we pass farther and farther away from the crest. Now this is exactly what we find in off-shore deposits. They are coarse sands and shingle near shore, and then become progressively finer seaward until in open sea, beyond the reach of even the finest mechanical sediments, they are replaced by organic sediments which form limestones. It seems evident, therefore, that the place of a mountain range before mountain birth was a marginal sea bottom, receiving abundant sediment from a contiguous continental land mass. This explains at once the usual position of mountains on the borders of continents. Here then is one important point gained.

But such enormous thickness as we often find would be impossible unless the conditions of sedimentation on the same spot were continually renewed by *pari passu* subsidence of the sea bottom. And we do indeed find abundant evidence of such *pari passu* subsidence not only at the present time in places where abundant sediments are depositing, but also in the strata of all mountain ranges. In the 40,000 feet thickness of Appalachian strata nearly every stratum gives evidence by its fossils of shallow water, and often, by shore marks of all kinds, of *very* shallow water. Therefore the place of mountains while in preparation in embryo, before birth, was gradually subsiding, as if borne down by the weight of the accumulating sediments; and continued thus to subside until the moment of birth, when, of course, a contrary movement commenced. The earth's crust on which the sediments accumulated was bent into a great trough, or what Dana calls a geo-syncline. This is another important point gained.

But let us follow out our logic. If the earth's crust yields under increasing weight of accumulating sediments, then ought it also to rise under the decreasing weight of eroded land surfaces. If it sinks by loading, it ought also to rise by unloading. And such indeed seems to have been the fact. For if all the strata which have been removed from existing plateaus and mountains were restored, it would make an incredible height of land. At least 10,000 to 12,000 feet have been carried away by erosion from the Colorado Plateau region, and yet 8,000 feet remain. At least 30,000 feet have been worn away from the Uinta Mountains, and yet 10,000 feet remain. Evidently there has been a rise *pari passu* with the lightening by erosion.

May we not then safely generalize? May we not conclude with Dutton that the earth in its general form and in its greater inequalities is in a state of gravitative equilibrium—that the earth is an oblate spheroid only because this is the form of gravitative equilibrium of a rotating body; that ocean basins and continental protuberances exist only because the materials underlying the former are denser and underlying the latter lighter than the average. It is true that the spheroid form of the earth and the sinking and rising of the crust by loading and unloading may be explained on the supposition that the earth is liquid beneath a thin crust, but to this view there are three fatal objections: 1. The cosmic behavior of the earth is that of a rigid solid. This I believe to have been demonstrated. 2. The existence of the present great inequalities of the earth would be impossible, except under the most improbable conditions. For example, if the earth be fluid, then the crust must rest as a floating body. But if so, then by the laws of floatation, for every continental protuberance on the upper side, there must be a corresponding protuberance in reverse on the other side of the crust, and for every great plateau or mountain range, there must be a corresponding plateau or mountain range in reverse. And taking the difference of specific gravity of the floating crust and the supporting liquid to be as great as that between ice and water, these reverse inequalities must be ten times as great as those at surface! Can we accept so violent a hypothesis? But (3) repeated experiments, especially very recent ones by Carl Barus,* prove that rocks increase very notably in density in the act of solidification, so that a solid crust would undoubtedly break up and sink in a liquid of the same material. But how then are we to explain gravitative equilibrium in the case of a rigidly solid globe? I answer, by two suppositions: 1. That the earth, though rigid as glass or even steel to *rapidly* acting force, yet yields viscously to heavy pressure *over large areas* and acting for a long time. A solid globe of glass six feet in diameter will very perceptibly change form under its own weight. How much more the earth under its own gravity. This completely explains the oblateness of the earth, even if solid throughout, and had never been liquid at all. The earth, though rigid, behaves like a very stiffly viscous body, like, for example, the ice of glaciers, though very much more stiffly viscous. This viscosity would not at all interfere with its rigidity under the tide-generating influences of the sun and moon—for these are far too rapidly acting.

2. The second supposition necessary is that the earth is *not* absolutely *homogeneous* either in density or in conductivity for heat; that in secular cooling and contraction the denser and more conductive areas cooling and contracting faster went down and became the ocean basins, while the lighter and less conductive areas were left as the more prominent land surfaces. And thus to-day the ocean basins are in gravitative equilibrium with the continental areas, because in proportion as oceanic radii are shorter are the materials also *denser*, and in proportion as the continental radii are *longer*, are the materials also specifically *lighter*. This condition of gravitative equilibrium Dutton calls Isostasy.

Thus then the great inequalities of the earth constituting ocean basins and continental surfaces are the result of *unequal* radial *contraction of the earth* in its secular cooling. This is by far the most satisfactory theory of these *greatest* inequalities.

In thus following the phenomena of isostasy to their logical conclusion, we seem to have gone beyond the limits of our subject, which is the *theory of mountains;* but the close connection which probably exists between the cause of continents and the cause of mountains justifies the digression, if such it may be called.

*Inferences from 3 and 4, Folding and Cleavage.*—Still adhering closely to observed facts, there are some necessary inferences from folded structure and cleavage. These structures are indisputable proofs that mountain strata have been subjected to enormous *lateral* pressure at right angles to the trend of the axis, by which the whole mass has been mashed together horizontally. But such horizontal mashing must of necessity produce corresponding up-swelling along the lines of yielding. In a word, it is evident that mountains have been uplifted largely at least, if not wholly, by horizontal mashing. The only question that remains is: Is lateral mashing alone sufficient to produce the highest mountains? Let us see.

The amount of uplift in such cases would depend on two things, viz., the thickness of the strata and the amount of mashing. Now, as already shown, mountain sediments are 30,000, 40,000, and even 50,000 ft. thick. The amount of mashing in many mountains is almost incredible. In the Appalachian it is so extreme that in one place, according to Claypole, 96 miles of original sediments have been crowded into 16 miles and the shortening of the whole Appalachian breadth is estimated as 88 miles.* In the Alps the shortening is estimated by Heim as 72 miles, or one-half the original breadth of the sediments. In a word, we may, without exaggeration, say that in great mountains the original space is to the folded space as two to one, or even as three to one. Now, a crushing of 30,000 ft. of sediments into one-half their original space would double their thickness, which is equivalent to a clear elevation of 30,000 ft. But strata are 40,000 and 50,000 ft. thick. Evidently, then, this method alone is sufficient to account for the highest mountains in the world, even allowing for the enormous erosion which they have suffered.

The same is equally shown by the phenomena of slaty cleavage so often associated with folded structure. Slaty cleavage, as has been demonstrated by experiment as well as by field observation, is produced by a mashing together of the whole rocky mass in a direction at right angles to the cleavage plane and a corresponding extension in the direction of the *dip* of these planes. Now, since the cleavage dip is usually nearly or quite vertical, this means a mashing together *horizontally* and a proportionate extension *vertically*. The amount of mashing together horizontally and extension vertically has been in many cases somewhat accurately estimated. In this case also, as in folding, we have evidence of a mashing of 2 or even 3 into 1, and a corresponding extension vertically of 1 into 2 or even 3. This amount of extension affecting thick strata is sufficient to account for the highest mountains in the world, without resorting to any hypothetical force pushing upward from beneath.

There seems, therefore, to be no reasonable doubt that *mountains are formed wholly by lateral crushing with proportionate up-*swelling. This is a very important point gained. Let us hold it fast. This brings me naturally to the next point.

*Inferences from 5 and 6, Granitic Axis and Asymmetric Form.*—A granitic or metamorphic axis is a very general though not a universal characteristic of mountains. The old idea (still held by some) was that fused matter was pushed up through and appeared above the parted strata along the crest as the granite axis, lifting the strata, as it were, on its shoulders to form the slopes. But it must be observed that the axis is often only metamorphic, not granitic, and, moreover, that some mountains are composed wholly of folded strata alone. If, therefore, we regard granite as often only the last term of metamorphism, we may more properly speak of the axis of mountains as metamorphic. If so, then it is not necessary to suppose any vertical uprising of fused matter by volcanic forces at all. On the contrary, we would explain the axis thus:

It is evident that accumulating sediments must cause corresponding rise of the interior heat of the earth toward the surface, so as to invade the lower parts of the sediments and their included water. Now it is well known from the experiments of Daubre and others that in the presence of water, even in small quantities, rocks become softened and even hydrothermally fused at the very moderate temperature of 400° to 800° F. It is certain then that such thickness of sediments as we know, accumulated in preparation for mountain birth, must have been softened to a degree proportionate to the thickness, and therefore perhaps semifused or even fused in their lower parts along the line of *thickest* deposit, and therefore of greatest subsequent elevation. On cooling after elevation, this sub-mountain of fused or semifused matter would form a granitic or metamorphic *core* beneath the highest part. The appearance of this core as an axis along the crest is the result not of upthrust, but of *subsequent* erosion greatest along this line.

And this in its turn furnishes a key to the location of mountains along lines of thick sediments. For not only the lower parts of such sediments, but also the sea floor on which they are laid down would be hydrothermally softened or even fused. Thus would be determined a line of weakness, and therefore a line of yielding to lateral thrust, and therefore also a line of crushing, folding and upheaval. The folding and the upswelling and the metamorphism would be greatest along the line of thickest sediments, and become less as we pass away from that line. In extreme cases, however, the firmer lateral portions might be jammed in under the softer central portions, on one or both sides, and give rise to the fan structure characteristic of complexly folded mountains. Or again, in such cases the folds might be pushed clean over and broken at the bend, and then the upper limb slidden over the lower limb even for miles, forming the wonderful thrust planes of the Alps, the Appalachian and the Rocky Mountains already described. Thus the phenomena under (5) are completely explained.

But mountains are usually asymmetric, the crest being on one side. This is explained as follows: Sedimentary accumulations along shore lines are thickest near shore (though not at shore) and thin out slowly seaward. The cylinder lens formed by sedimentation is not symmetric, its thickest part being near one side, and that the shore side. This thickest line, as we have seen, becomes the crest, which therefore is asymmetrically placed on the land side or side from which the sediments were derived. The overfolding, on the contrary, is to the seaward.

(*To be continued.*)

* *Am. Journal*, vol. 45, p. 1, 1893.

* Heim, *Archives des Sciences*, vol. 64, p. 120, 1878.

† *Am. Naturalist*, vol. 19, p. 257.

## SOAP AS AN INSECTICIDE.

PROF. E. W. HILGARD, of the Agricultural Experiment Station of the University of California, reported some years ago on the effect of whale oil soap as an insecticide, and added the following interesting remarks:

"Among the ingredients of insecticide washes intended for summer use, or on evergreen trees, whale oil soap is one of those most commonly employed, as well as most generally approved, in California. It is quite effective in numerous cases, even when used by itself; but it is most commonly combined with, or made the vehicle for, other insecticide substances. Instead, common soft soap is also employed, but its chief merit lies in the fact that it, in common with all other soapy compounds, serves to conserve the efficacy and maintain the action of other insecticides for which it serves as a vehicle. This it does partly by virtue of its property of properly wetting even hairy, greasy or polished surfaces (whether of leaves or insects), from which simple water would rebound or gather in ineffective droplets; partly because it remains more or less moist, and in that condition forms a soft, clinging varnish, under which the action even of volatile agents (such as kerosene or the extract or powder of "buhach") can continue for some time without too much wasting of their strength into the surrounding air by evaporation.

"But whale oil soap possesses the additional advantage of having within itself special odorous substances of insecticide qualities, which impart to crude whale oil its intensely disagreeable odor. From these it is partly freed in the refining process by the action of a certain proportion of caustic alkali (mostly soda), which takes possession *preferably* of the odorous compounds of the crude oil, together with a certain proportion of the inodorous fat oil. This soapy mixture constitutes the 'foots' of the refineries, and is far more energetic in its insecticide effect than soap made from the whole of the crude oil, which contains a relatively much smaller proportion of the evil-smelling substances.

"This fact alone explains much of the diversity of opinion that has arisen in the matter of proportioning the strength of the soap washes to the desired effect. For not only has the soap made from the *whale* oil been supplied by some manufacturers, but those using the washes have, in many instances, made the soap themselves, in accordance with the common process of making soft soap at home.

"Matthew Cook, in his excellent book on the repression of injurious insects, prescribes that one pound of the soap dissolved in one gallon of water shall constitute the basis of the washes. Some have found this wash unnecessarily strong, while others have found it too weak to accomplish anything.

"In a bulletin issued in February last (No. 52) were given the analyses of sundry brands of 'lye,' from which it appeared they differ in strength as much as 500 per cent.; so that a person using the proportions prescribed for one kind would, in using the other, make his wash too strong or too weak, as the case might be, to that precise extent, either wasting his work or perhaps scorching his trees.

"An examination of the several brands of whale oil soaps in the San Francisco market has revealed similar differences between them. In this case the inert substance present to excess in some samples is simply water, which was found to range in different preparations *sold at the same price*, from 21 to as much as 82½ per cent. Curiously enough, the most highly-watered article was among the most salable, the reason being, probably, that while the article having nearly 80 per cent. of soap and 20 of water is somewhat difficult to dissolve and has to be boiled, the one in which these proportions are reversed can be made into a wash by simply stirring it into cold water. But apart from this inconvenience, the one is actually and indisputably worth fully four times as much as the other for the purpose it is intended to subserve, provided the user will take trouble to put in the water himself instead of having it shipped to him from San Francisco.

"It is no wonder that the experience of fruit growers differs widely as to the efficacy of whale oil soap in ridding their trees of insect pests!

"From a comparative examination of the samples on hand it appears that a whale oil soap containing about 50 per cent. of water is as readily dissolved as any moderately energetic fruit grower need desire; and, in view of the relatively small weights of invoices usually shipped of this article, I suggest that it would be convenient to users if all manufacturers would adopt the standard of 50 per cent. of dry soap to be contained in whale oil soap, as offered for sale. There will then be some definite meaning to the prescription of 'a pound to the gallon,' and disappointments after the proper use of washes prepared according to the best experience will cease to occur."

The County Board of Horticultural Commissioners of Sutter County, Cal., recommend the whale oil soap and sulphide of potash wash for the summer spraying of deciduous trees, infested with the San Jose scale, red spider, yellow mite, etc. The following is Prof. Hilgard's formula, and is used throughout the State, being not only cheap but easily mixed and quite effectual for summer spraying. To accomplish the best results this wash should be applied after the scale are hatched and while they are crawling on the trees. It is impossible to state the date when this occurs, as it

varies according to the season and the weather, but it is usually about the first of May in that part of the State. All infected trees should be often examined, and when, with the aid of a magnifying glass, the young scale can be seen crawling on the tree, no time should be lost in applying the remedy.

WHALE OIL SOAP AND SULPHIDE OF POTASH REMEDY.

| | |
|---|---|
| Whale oil soap (80 per cent. strength) ... | 20 lb. |
| Sulphur................................ | 3 " |
| Caustic soda (98 per cent. strength)...... | 1 " |
| Commercial potash .................. | 1 " |
| Water to make 100 gallons. | |

Place the sulphur, caustic soda and potash together in about two gallons of water and boil for at least an hour, or until thoroughly dissolved. Dissolve the soap in the water by boiling; mix the two and boil them for a short time: use 130° Fah. in vessel.

Prof. Hilgard recommends, in bad cases of scale and in fighting red spider, an addition of kerosene in the form of an emulsion to the above wash:

| | |
|---|---|
| Kerosene............................ | 1 gallon. |
| Whale oil soap...................... | ¼ pound. |
| Water ................................ | ½ gallon. |

Dissolve the soap in the water and then, boiling hot, add the kerosene. Churn the mixture for five or ten minutes with a hand spray pump until it forms an emulsion. If the emulsion is perfect, it will be of a creamy nature, no oil appearing on the surface. Add this to the 100 gallons of spraying material.

The sulphide of potash and the kerosene emulsion are often made up in large quantities and the proper amount added to the whale oil soap, as required. Keep this wash well stirred when using.

It is very important that the whale oil soap should be at least 80 per cent. strength. To test the soap, spread five or ten ounces of it on a tin plate counterpoised on a pair of upright scales reading to ounces, and then dry the whole by setting it on top of a pot of boiling water. The loss in drying will indicate the amount of water in the soap. Thus, if five ounces were taken and one ounce was lost in drying, the soap would be of 80 per cent. strength.—*Am. Soap Jour.*

## DRAGON'S BLOOD.

In the year 1569, Monardes published his *Historia Medicinal*, etc., and of this the famous Belgian botanist Clusius published a Latin version, with notes, in 1574. The original editions are not before us as we write, but it is desirable to note the dates at which they were published. In the French edition of Monardes, the *Histoire des Simples Medicamens apportés de l'Amerique* (1619), lib. v., cap. xxiv., we find it stated, as it probably is in the first edition to which we have referred, that the Bishop of Carthage had recently brought home the fruit of the tree whence exhudes the tear (larme) which is commonly called dragon's blood. Now, this fruit, our author goes on to say, is every way admirable, for as soon as the rind is removed, quite suddenly a little dragon appears, elaborated with such natural artifice that it appears as if sculptured in marble by some skilled workman. It has a rather long neck, the throat open, the backbone beset with spines, the tail long, and the feet well armed with nails. "Carthage," in Peru, is said to be the source whence the dragon's blood is derived, and its properties are described as highly astringent, and the drug is used in those cases where a medicament of that nature is required. Clusius, in a note, proceeds to describe what we now know as *Dracæna Draco*, of which a plant was raised from seed at Brussels. He describes the fruit, but he is careful to add that there was no dragon in it.

Gerard, in his *Herbal* (1597), p. 1339, under the head of *Draco arbor*, the dragon tree, unblushing copyist that he is, gives the same figures, and a good description of the *Dracæna Draco*. The external appearance of the fruit is well described, and then it is further stated that there "is to be seene, as Monardus and divers others report, the forme of a dragon, having a long necke or gaping throat; the ridge or backe armed with sharpe prickles like the porpentine: it hath also a long taile, and fower feet, very easie to be discerned; the figure of it we have set foorth unto you according to the greatness thereof, because our words and meaning may be the better understood." Gerard then, as Clusius had done before him, assigned the fruit with the dragon in it to what we now know as *Dracæna Draco*, although, as we have seen, Clusius is careful to say that he could not find any dragon in it. The dracæna also offers a difficulty, inasmuch as it is a native of Teneriffe and Madeira. But Gerard is equal to the emergency, for he goes on to say of his dragon tree that "this tree groweth in an Iland which the Portingales call Madera, and in one of the Canarie Islands called Insula Portus Sancti, and as it seemeth it was first brought out of Affrike, although some are of a contraire opinion and say that it was first brought from Carthagena in Nova Orbe by the bishop of the same province." In any case the sixteenth century botanists attributed the "dragon's blood" to the vegetable kingdom, but their far-off predecessors were less metaphorical in their notions. Pliny, for instance, in his *Natural History*, book xxxiii., cap 40, says dragon's blood (which was used as a "vehicle" or as a pigment by artists) is a thick matter issuing from the dragon when crushed beneath the weight of the dying elephant. Elsewhere Pliny (book xxxv., cap. 32) speaks of India sending to Rome the slime of her rivers, and "the corrupt blood of her dragons," and this fact serves him as an illustration of a tendency which is apparent now as then. "Everything, in fact, was superior at a time when the resources of art were so much fewer than they now are. Yes, so it is; and the reason is . . . that it is the material, and not the efforts of genius, that is now the object of research." (Bohn's edition, vol. vi., p. 246.) The question to be solved is, What was the fruit mentioned by Monardes, and which contained so striking a verisimilitude to a dragon? A conventional dragon it must have been, like the effigy at Temple Bar, perhaps, for no one quite knows what a dragon was! What is known nowadays as dragon's blood is a resinous exudation used for varnish, and derived in some cases from a palm, *Calamus Draco*, in others from a dracæna. Now, the palm has a scrambling stem thickly beset with spines, and its fruits are covered with hard scales turned down, and dragon-like as dragons are supposed to go, but the calamus comes from Sumatra and Borneo, and not from Carthagena. In spite of its name, it is rather difficult to see any resemblance to a dragon in a dracæna. Perhaps the bayonet-like leaves may have suggested the idea.—*Gardeners' Chronicle.*

## POLYGONUM SACHALINENSE.

We give an illustration of the plant producing its seed vessels. The plant was first described by F. Schmidt in 1853, and on its introduction to our gardens in 1869 or 1870, by Mr. William Bull, it was made the subject of a descriptive notice by ourselves in our volume for 1870, December 3, p. 1599, and again in 1886, December 25, Fig. 158 (here reproduced). Its great merits as a decorative plant have since been generally recognized. Our distinguished colleague, M. Ed. André, introduced it into France from Moscow in 1869, but it was not till quite recently that M. Doumet Adanson called attention to its value as a forage plant. As some confusion has arisen in the conversion from the simple metric system of weights and measures to our preposterously absurd muddle, we repeat the figures as given by Messrs. Doumet Adanson and Baltet. The total weight of produce in the green state varies from 20 to 40 kilogrammes the square meter, or 200,000 to 400,000 kilos. the hectare, equaling 200,000 lb., or 89 tons, 6 cwt. 16 lb. to 178 tons, 12 cwt. per English acre, or nearly double the weight of a crop of cabbage planted at 2 ft. apart and each plant weighing, when full grown, 10 lb.—*The Gardeners' Chronicle.*


POLYGONUM SACHALINENSE. (RECOMMENDED AS A FORAGE PLANT.)

## SELECTION OF SORGHUM SEED.

The recently published results of seed selection at Calumet plantation have awakened general interest in seed selection, and a brief statement of methods now used in selection of sorghum seed at Sterling, Kansas, may have interest for some.

The present work in seed selection, at Sterling, consists in selecting the largest and finest canes, which mature a week or more earlier than average canes growing in the same field, and in again selecting from the selected canes those which have the best quality of juice, so that there is, first, a selection of the best and the ripest, by the eye, and from these a second selection by test of the juice of each cane.

There is an evident advantage in having a thousand tons or more of early maturing cane which can be worked in a sugar factory, so as to get the factory in running order while the bulk of the crop is not yet ready to be worked. It is the same as lengthening the running season. We cannot defer frost, but we may grind sooner.

The Department of Agriculture has experimented with many early maturing varieties of sorghum, but all of these have been discarded except two, because they were inferior in size or in quality of juice. The effort now is to cause the two best early maturing varieties to mature still earlier by selecting seed from the canes which mature first. These selections are made best before any of the canes are fully mature, and while the color of the seed tops aids in judging the degrees of maturity of the canes. After all the canes have ripened it is impossible to determine which canes ripened first, and it is difficult to judge the degree of maturity after all of the seed tops have acquired the color of ripeness.

For this reason selection of the earliest maturing canes should be made before any have fully ripened. This implies the selection of seed which is more or less immature, but it has been found that such seeds germinate well, and give a good stand of cane in field planting. There are some who believe that the planting of partially ripened seeds induces earlier ripening, as plants, for instance, taken from south to north ripen earlier, though, perhaps, because the seeds at first only partially mature.

Generally, early maturing varieties produce smaller plants than later maturing varieties, but it is believed that this tendency to become smaller as the canes mature earlier may be counteracted by selecting seed only from the larger canes which ripen in advance, and for this reason only the larger canes are included in the selections. There seems to be nothing incompatible in the belief that vigorous and quick-growing canes may be found which ripen early, are not lacking in weight, which have juice of superior quality, and which transmit these qualities. By making early selections at the proper time, it is easy to find canes of full size, which have superior juice, and which mature from one to two weeks earlier than average canes. In some cases, perhaps in many cases, this earlier ripening is due to accidental causes and not to a peculiarity of the plant. But as the selections include canes

which are naturally precocious with the accidentally early canes, subsequent selections in another year from canes produced by present selections will reject many of the accidental selections.

After the canes have been selected in the field they are passed through a small mill separately, and the density of the juice of each cane is determined with a saccharometer. Many thousands of analyses of sorghum juice show that the density of the juice from fresh cut sorghum canes is a reliable indication of the quality of the juice. The density of sorghum juice is probably as correct an indication of its percentage of sugar as is the density of beet juice or of sugar cane juice. Where rapidity is more essential than extreme accuracy, the test of density is sufficient for selection or rejection of canes for seed. The mingled juice from the finally selected canes is analyzed, giving the percentage of solids, of sucrose, and of purity, of the selections together, thus greatly reducing the number of polarizations and increasing the number of selections which can be made.

As an example of the methods used, August 10, 1893, 160 of the largest canes, which were a week or more in advance in maturity of the average canes growing in a ten acre field, were milled separately. The juice from 8 canes had a density of 19 and over brix, 59 canes gave 18 plus brix, and 93 canes showed a density of 17 degrees brix, while the average of the cane in the field would have been less than 17 brix. The mixed juices of the 8 selected canes showed 14·1 percentage of sugar, 75·5 purity. The seeds from these vigorous and early maturing canes of good quality should produce next year larger, richer and earlier maturing canes than unselected seeds. It is only desired to hasten the maturity of two early varieties, and later, selection will be based only upon quality, size and type of the canes.—*La. Planter.*

## AMONG THE AUSTRALIAN ABORIGINES.*

THE weapons used by the aborigines of Australia are very primitive and peculiar, for these savages are still in the stone age.

The nullah and the waddy are clubs of different sizes, made of a very hard wood called ironwood. The arrows used by the Australians are two meters in length. They are of wood of the diameter of the little finger, sometimes toothed, and hardened by fire or provided with a flint shaped like a lance head. The natives send these arrows to a distance of 50 or 60 meters with great precision by means of the womerawa, a very peculiar sort of shooting stick. The womerawa is a piece of wood a meter in length, six centimeters in width at one end and running to a point at the other. This extremity is provided with a small hook which is introduced into an aperture formed at the extremity of the arrow. Then the womerawa, being grasped by the wide part, is used as a lever for throwing the arrow. (Fig. 3.)

The tomahawk is a stone or sometimes a piece of sharpened jasper fixed to the extremity of a split stick. This instrument is used by the Australians as a hatchet.

The most curious of their weapons is the boomerang. It is a piece of hard wood of incurved form, from 60 to 80 centimeters in diameter, of from 4 to 6 centimeters at the widest part and tapering toward the extremities. The concave part is from 2 to 4 millimeters in thickness. The convex part has a sharp edge. Thrown by a native, this instrument is capable of going horizontally, remaining at a height of about 1 meter from the ground, for a distance of from 20 to 30 meters. Reaching this distance, it suddenly rises in the air to a height of from 10 to 20 meters, describing a wide circle as it does so, and finally drops at the feet of the one who has thrown it. During the whole time of its evolution the boomerang turns upon itself with great rapidity, as if it were revolving around a pivot, and produces a sharp whistling sound. It is difficult to understand what law of projection the boomerang obeys in order to follow the different directions that we have just indicated. In the hands of Europeans it is a dangerous weapon, for it is apt to return and strike the person who throws it. The aborigines use it in hunting for killing opossums or parrots. They employ it also in war, and succeed in striking an enemy sheltered behind a tree.

In order to obtain fire, the Australians make use of the wood of the grass tree (*Xanthorrhœa*), a plant of curious aspect that covers a large number of prairies in Australia and which is shown in Fig. 2. In a stick placed upon the ground they form an aperture in which, with their two hands, they rapidly revolve another stick of the same wood until fire is produced. The operation takes scarcely a minute.

The religion of the aborigines is quite vague. They have no idols; they believe in spirits, which they hold in great dread; they adore the moon, and also, under the name of Baiame, a supernatural spirit, who is master of all.

Circumcision is practiced commonly among the aborigines, particularly in the tribes surrounding the Gulf of Carpentaria. They have small pieces of jasper especially shaped for this purpose.

Respect for the dead is very pronounced among them. They deposit the bodies of the latter upon platforms of foliage in the forked branches of trees. The chiefs are covered with bark and placed in the trunks of trees. They leave the bodies to get dry and return to divide their bones and nails, which are regarded as precious relics capable of warding off evil spirits. They often eat the heart and liver of a great chief, in order to inherit his virtues and courage.

They formerly interred their dead upright in the earth or else seated with the head projecting from the surface and covered with stones and foliage, in order to protect it against the teeth of carnivorous animals.

Their medicine is primitive, and the physicians work upon the credulity of their patients in order to suggest a cure.

For liver diseases, for example, after a succession of cries and groans, uttered to strike the imagination and surround themselves with a certain professional prestige, they simulate, through a play of hocus-pocus, the extraction of a stone through the skin of the sufferer. They repeat the operation until the assistants are completely fatigued, and, when they stop, they affirm that the patient is better.

For rheumatism of the leg the doctor attaches the end of a cord to the ailing part and passes the other end several times over his gums until they bleed abundantly. He then spits out this blood, which he pretends to come from the patient through some mysterious channel, and which, he says, has the property of carrying away the disease.

Their surgery is just as childish. They content themselves with surrounding a broken limb with vines, which they tighten to as great a degree as possible. For wounds they use the gum of eucalyptus. They treat ophthalmia by keeping the patient for several days in a hut in which a thick smoke of green wood is kept up.

At the beginning of the colonization it was necessary to fight the aborigines, and the squatters were on a war establishment with them. They stole sheep, assailed and burned the stations, in which one lived always in danger of an attack. If they succeeded in seizing a white person, they tortured him before killing him. One unpunished crime inevitably led to others, and the English had to defend themselves as they best knew how. The blacks were killed without mercy. In order to get rid of these black robbers, bags of flour poisoned with strychnine were placed within their reach. All the stations are provided with this poison, which is used for exterminating wild dogs. Recourse was had also to a native police. Those who agreed to form a part of this police became ferocious against their old comrades and tracked, hunted and burned them without mercy. When they happened to approach a camp, they surrounded it with a serried cordon and set fire to the surrounding prairie, and the blacks, in order to escape, were obliged to pass within reach of the police carbines.

At present there no longer exist any completely savage tribes.

In Fig. 1 we reproduce a photograph that shows us an Australian warrior singularly tattooed—one of the

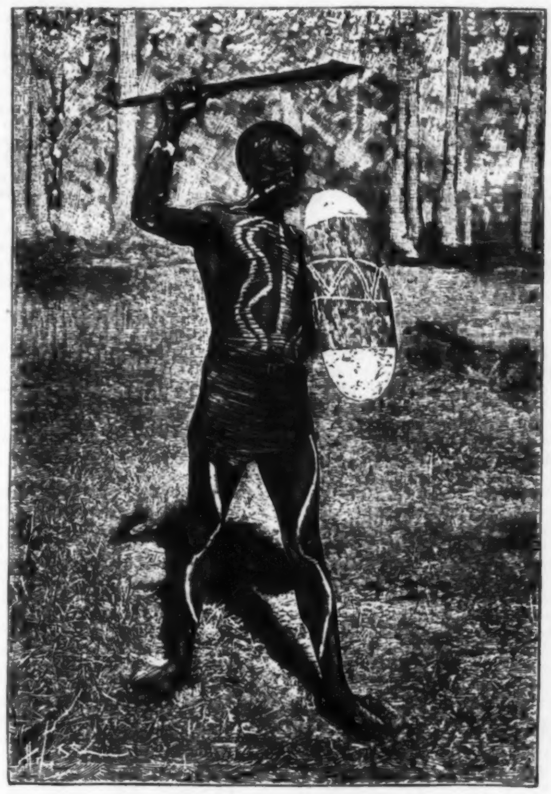


FIG. 1.—AUSTRALIAN SAVAGE WITH HIS WEAPONS OF WAR.

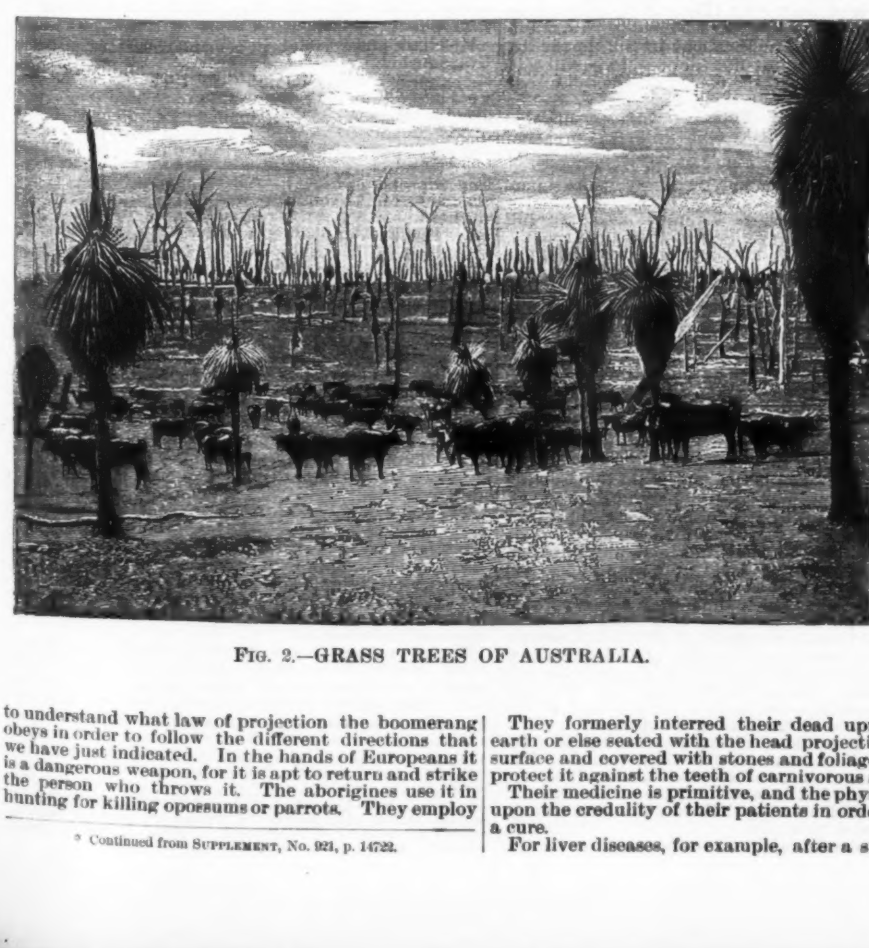


FIG. 2.—GRASS TREES OF AUSTRALIA.

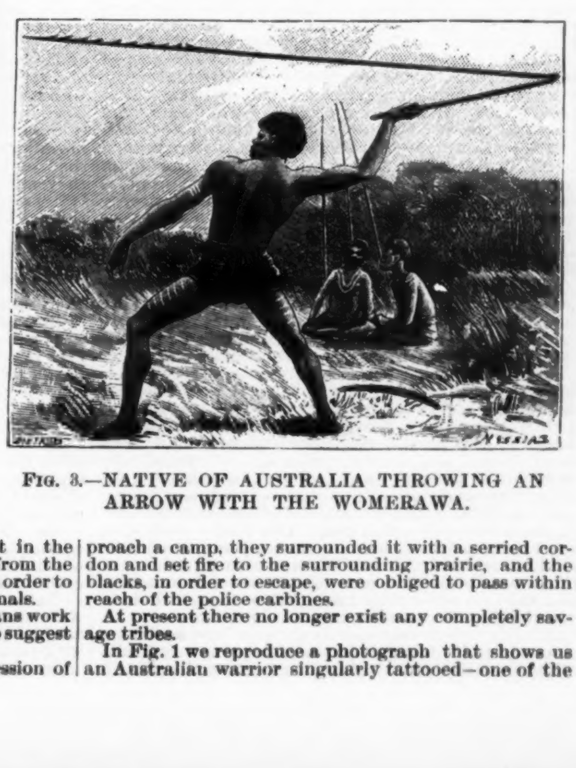


FIG. 3.—NATIVE OF AUSTRALIA THROWING AN ARROW WITH THE WOMERAWA.

* Continued from SUPPLEMENT, No. 921, p. 14722.

last representatives of this disappearing race. The aborigines, as a consequence of their contact with the whites, have become apathetic and inoffensive. They are of little use from the standpoint of colonization. They can be utilized only as shepherds. They ride on horseback very well, and are relatively devoted if a little regard is had for them. They are unable to devote themselves to steady work, and obey the irresistible need of resuming a savage life from time to time. They are free to work according to their fancy, the government forbidding any one to oblige them to sign contracts that would make true slaves of them.

Unfortunately, they have taken from the whites the alcohol habit, and gin is doing its devastating work among them. The Chinese introduced the use of opium, and in many districts they refuse all work upon a sheep station if they are not furnished in advance with a supply of this narcotic.

The diseases of the whites cause this population, free from all previous contamination, to pay a large tribute. This people, which a hundred years ago occupied itself alone the great Australian continent, is incapable of responding to the too abrupt efforts of a civilization too advanced for it. It will disappear as disappeared fifteen years ago the blacks from Tasmania after fifty years of colonization.—*La Nature.*

## THE HOTTENTOTS OF SOUTH AFRICA.

By NICOLAS PIKE.

THIS singular race of people are supposed to be descended from the aborigines of South Africa. Col. Hamilton Smith, in his work on the "Human Species," p. 212, says, the Housana nations, the Hottentots, Bushmen, Coranas, etc., all of a lemon peel or dirty yellow color, and often with strange peculiarities of form; speaking dialects inimitably articulated, and possibly forming a hybrid race of Mongolo-Papuan origin; one flung abroad at so remote a period as to have preceded both the true woolly-haired tribes, the Ethiopian and the Caucasian nations, since they, together with the Ompizee of Madagascar, a portion of the inhabitants of Fernando Po, and the ancient Guanches of Teneriffe and the islands of the west coast, seem to have belonged to the same origin, and to have been driven off in all directions by the negroes who succeeded them, until at a later period they effected interunions, which form some of the modifications among the black tribes and constitute the existing populations above named. That certain tribes of a partially civilized race pre-existed in the present Caffraria is even proved by the rectangular stone walls of old (Leetakoo, in the Caffre dialects, denoting the old stone buildings), the ruins of which still remain in a country where the Amazula, Bachapin, or Caffre population never have built a house but of reeds and clay.

About the middle of the seventeenth century the Dutch East India Company began to colonize the southern angles of the African continent. At this time the Hottentots were very numerous and spread in hordes or bands all over this part of the country. They were divided into many classes or tribes, and were governed by their respective chiefs. The name Hottentot, Barrow says, is a fabrication, as it is a word that has no place or meaning in their language, and they take to themselves the name under the idea of its being a Dutch word. Whence it has its derivation, or by whom it was first given, no one has been able to trace. Webster says the name is derived from "hot" and "tot," two syllables of frequent occurrence in their language.

When the country was first discovered they were an independent people, although each tribe had its particular name, but that by which the collective body as a nation was known at this time in every part of the country was "Quaiquae," although the real and proper name is "Quaqa." The Hottentots are not an agricultural people, and did not till the land, but their only occupation was that of the chase and taking care of their herds and flocks. They were famous sportsmen, often attacking the elephant, lion, and tiger, which abounded at that time, and a constant warfare was going on for the protection of their flocks and herds from beasts of prey of every kind. Their only arms, which were used alike for war and the chase, were a javelin, or what is better known to us as the "assagai." This with the bow and poisonous arrows in their tribal wars which frequently occurred formerly were formidable weapons when skillfully used. These arrows were poisoned with the juice of the *Scileroxyrum toxiferum* or gift boom, better known to Europeans as the poison tree. The juice of this tree is allowed to ferment slightly, and the points of the arrows are dipped in the solution. They are terrible, destroying everything that they penetrate in a very short time. It is said by early writers that their intestine wars were always tempered with mercy and were never so bloodthirsty as those of other African tribes. They are a peaceable race when treated with kindness, although they are by no means deficient in courage. As a proof of this the fact of their having encountered the viceroy of the Portuguese and his attendants when he was at Cape Town and killed and routed them. This engagement took place near Cape Town, at a place called Fish River.

The arts of bravery and heroic devotion exhibited by these people is scarcely to be surpassed in the history of any other people. Their mode of life is very primitive, living in huts or "kraals" rudely made. The chase and their herds occupy most of their time.

Their habitations are comfortable and very simple in construction, and answer well for the climate, and are made as follows: After a suitable place is selected, a circle is drawn upon a level spot about twenty feet in diameter, and around this about twenty small holes are excavated, and as many poles are cut (principally the willow). The large ends of these are inserted in the holes in an upright position and covered in. A large pole is cut and a hole is made in the center of the circle about fourteen inches deep. This is also covered in. Then the tops of all but the center pole are bent inward and securely fastened to the center upright pole. These are firmly secured with sinews and thongs of wild animals, principally taken in the chase. A skeleton of a hut or kraal is now ready for covering in. Small twigs and coarse grass are now interwoven between the poles, which form the frame of the structure.

After this is done it is ready for the thatch. This is composed of long, tough grass, that has been perfectly dried. Thatching is commenced by laying the first row at the bottom of the structure, and four or five inches of this is buried under ground. This thatch is continued till layer after layer covers in the whole structure. A small round space is left open to be used as an entrance or door. Sometimes a small opening is made near the top for ventilation and air. After the exterior is finished, it has the form of a beehive. A plaster is now formed of fresh cow manure, mixed with sand, equal parts. This is laid on the walls of the interior, and oftentimes we have seen the whole interior plastered with it, and when dry forms a hard smooth surface. It is often washed with size made of pipeclay and wood ashes, diluted with sour milk. This makes a fine hard finish, which is durable, as the climate is so dry. The floor of this cabin is now prepared in the following manner: First it is made level and all stones removed from its surface, and a large quantity of earth procured from the ant hills. This is generally found much broken up by the ant eaters. It is, however, finely pulverized, and when it is sprinkled with water and spread, it dries into a smooth, durable floor, which becomes as hard as a brick.

This earth from the ant hills contains an immense amount of matter which has great adhesive qualities when moistened with water, and dries quickly.

Sometimes a different style of kraal is made. It consists of small poles tied together at the smallest ends, which, when secured, can be folded up like an umbrella; when wanted for use they are opened out and covered with mats made of grass and sometimes skins of animals. This hut or kraal is the property of the wife, and in its erection, removal, and repair she receives no assistance from her husband. A young woman no sooner entertains a matrimonial proposal than she sets about the making of mats, accompanied by a friend or two. She trudges off to the river or other locality where the particular kind of reed is to be found, and after many days returns with a sufficient quantity. The cord or twine which she also needs in the construction of the mats to cover the kraal cannot be had for love or money. Another journey has to be undertaken to obtain the fine inner bark of the white thorn tree, which she strips off and carries home for manipulation. I should have said mastication and manipulation, for the one process must precede the other, as the bark must be chewed in order to separate its fibers and fit it for manipulation into twine. The lady now summons a number of children to assist in manducation. It is with this view that the long strings of bark are first steeped in milk or mutton broth before they are handed to the hungry brats, whose juvenile jaws never cease to grind while a drop of liquid remains to be extracted. A little further preparation fits the fiber for being twisted by the hand into a strong and even twine, by means of which the reeds are threaded together with a stiletto formed out of the shank bone of the ostrich. The hut remains the property of the wife and is protected by laws in force among them. She lodges whom she thinks proper, irrespective of the husband's will or convenience. If anything should occur to mar connubial harmony by the husband being refractory, the offended dame literally pulls the house about his ears; she rolls up the matting, takes down the poles, defies any one to touch them, marches off with her herds to her friends, and leaves her lord and master out in the cold. Overtures of submission from repentant husbands generally follow this summary proceeding. These kraals are used principally by the roving tribes, who can move not only his house, but all his household and its effects, consisting of pots and pans, which they make of clay, also one large iron pot, which is found in every kraal for cooking their food—all can be placed on the back of an ox and moved in a few minutes.

This is sometimes done when the grass is not sufficient in quantity for his herds of cattle and sheep. These kraals are universally used by the present race of Hottentots, who are much mixed by intermarriage. Milk is a great article of diet with them; it is allowed to thicken before it is used for food. They have a singular custom with them: The female portion of the family, as well as the children, are not allowed to partake of this or any other food till the master of the house has satisfied his appetite, and then, what is left can be taken indiscriminately. They show a remarkable knowledge in raising cattle and sheep, and are very successful. All the meat they use for food is raised by them, except the game they procure in the chase.

The men are very ordinary, and, take them as a people, are about as ugly-looking a race as we have ever seen in Africa. The men, as a general rule, are tall and straight, and are very quick in their movements, and are considered fleet on the foot and superior to the Indians as runners. They have broad, flat noses and large lips; have large heads and frizzled hair; their skin is of a dark brown, though they make themselves black by covering their bodies with soot and grease, that makes them look like demons, especially when they use other colors, red, blue, white, and yellow, laid on in streaks all over their bodies, as I have seen them. These fatty, greasy compounds which they use are very offensive, as they become rancid in the hot sun. They wear a narrow girdle round the loins and a sheep or other skin over the back. This is called a "kaross," and is the only clothing he makes use of. They bruise to pieces the left gland in the scrotum of the male children when quite young, for what reason no one knows, unless it is in the hopes that they may beget male children, rather than females. They are under the impression that the female children originate from the left and the male from the right of that organ. They have a custom of making youth, at a certain age, men, from which time they are separated from the women, and associate only with the men. After the youth has been sprinkled with urine, according to custom, some animal is killed and the omentum or caul is tied about the neck. He is then supposed to be marriageable. The men often take one or more wives. The marriage ceremony is simple, and is frequently performed by the bride and bridegroom. After obtaining the permission of the parents, sleeping together makes them man and wife. They seem to live in harmony with each other; the husband always claims supremacy in the family. They are honest and faithful (we found them so). We had one as a servant, who gave great satisfaction.

Travelers and writers differ in regard to the female Hottentot. Barrow says of them that they are by no means devoid of symmetry when young. They are clean-limbed, well proportioned, and erect; their hands and feet and all their joints are remarkably small. Their cheek bones are high and prominent, and, with the narrow, pointed chin, form nearly a triangle; the nose is in some remarkably flat, in others considerably raised. The color of the eye is a deep chestnut, and the eyelids at the extremity next the nose, instead of forming an angle, as in Europeans, are rounded into each other exactly like those of the Chinese. Their teeth are beautifully white. Barrow must have seen those of a mixed race, born of Europeans, or white fathers, of which I shall speak later on.

The color of the skin is like the North American Indian. Many of these people are nearly as white as some Europeans. When young some of them are fairly. The hands and feet are small and the whole body is without an angle or disproportionate protuberance, which shows itself later in life. Their gait is not deficient in easy, graceful movements. Their charms however are very fleeting; for, after they are married and have children, they become short and squatty, and are as ugly as the men. The whole body seems to change, the breasts become flabby and dangle down to the waist, which they can toss over their shoulders for the child to suck, which they carry on their backs, the child resting on their buttocks, which grow very large and prominent. Sometimes it is fastened by a strap that passes under the protuberance of the mother, which makes it secure, the mother all the while attending to her business as usual. It is, however, a fact that the cross between the white race and these women, when young, produce not only fine formed and pretty children, females in particular, who grow up tall and elegantly formed, with fine and beautiful features, almost white, with not more color than the ordinary brunette. We have seen some that we could not but pronounce perfect beauties. The charms in the Hottentot women are of short duration, for, as they grow old, I think they are certainly the most hideous-looking race on earth.*

A glance at the photograph taken from life will give a better idea than words can convey. The only clothing of the females in their native wilds is a small girdle, or skin around the loins. Give a Hottentot girl a bright colored handkerchief and a red shawl, and with the former she will make a turban for the head and the latter a "kaross." This will form her full dress.

The "kaross" will hang from her shoulders down her back, and she will feel as proud as a New York belle with one of Worth's famous costumes adorning her person. She will promenade in all her glory in the hottest noonday sun, her chin carried well up, her hands resting on her hips with the elbows drawn back, her gait listless and sauntering, her body inclined gently forward and all innocent of padding, as her rounded contour is. You have an attitude as striking as the "Grecian bend" of the most accomplished coquette. They often paint their bodies in a most hideous manner after the custom of the North American Indians. This is done always when they are preparing for a festival. They adorn their legs and arms with entrails of the sheep, which they blow up when fresh. They smoke tobacco, and are fond of jewelry. Their principal food is beef, mutton, and milk, and a bulb, which is common and grows all over the country. This they dry, grind up, and make it into a sort of bread, which is very good and wholesome. The natural fertility of the country makes the people lazy, indolent, and simple. The language of the Hottentot is indescribable. It is uncouth, chuckling, and gibberish, and nothing but a succession of clicks. I have tried to learn a few words, but failed. All the sounds are guttural, stifled, rattling clicks, rapidly given. The language is exceedingly difficult to learn. I have never met with any one that has mastered it, although some of the missionaries have made progress and have succeeded in educating the young Hottentots, who have been very useful to them. One can form an idea of the following story, which is a well authenticated fact: In the early time of the Cape Colony settlement one of the Dutch governors procured a Hottentot child and had him educated according to the manners and customs of Europe. Fine clothes were given him, and he was taught several languages, and his progress fully corresponds with the care taken of his education. Van Stell, the governor, entertaining great hope of his talent, sent him to India, under the protection of a commissary general, who employed him with advantage in the company's office. After the death of the commissary, this Hottentot returned to the cape. A few days afterward, while on a visit to some Hottentots, his relations, he formed a resolution of pulling off his European dress in order to clothe himself in a sheep skin. He then repaired to Van Stell in his new attire, carrying his old clothes and presenting them to the governor, addressing him as follows: "Be kind, sir, as to observe that I forever renounce these clothes. I am determined to live and die in the religion, manners, and customs of my ancestors. The only favor I have to beg of you is that you will suffer me to keep the necklace and cutlass which I now wear." After delivering this speech, he betook himself to flight without waiting for the governor's answer, and he was not seen afterward at the cape. Thus it will be seen that it is a difficult thing to civilize these people, as they prefer the wild and roving life of their ancestors.

They have a notion of the Deity, whom they worship with dancing and feasting, for generally they are much inclined to mirth. The bulk of these tribes are heathen, although mission stations are found among them, and these angels of mercy are surely spreading the Gospel, so much so that nearly all the bastard Hottentot races † are generally familiar with the truths of Christianity.

We once made a trip through what is called the Black Forest, in southern Africa, and had for our carriers a number of Gold Coast negroes and Hottentots. One day, by permission, they left our camp in the afternoon and remained away till after sunset.

* This is not so with those born of white of fathers, as I have seen children of the second generation which where beautiful specimens of humanity.

† Griquas, a bastard race of mixed blood of Dutch fathers and Hottentot mothers, dwelling under independent chiefs along the north bank of Orange River and south of Betjonanaland, and generally dispersed under the name of bastards through the colony.

They proceeded to the highest elevation they could find, which would give them a full view of the setting sun. Each man carried an empty tin can which had contained provisions. On the bottom of these they commenced a drumming and at the same time singing at the top of their voices, dancing and gyrating round, throwing their bodies into every conceivable shape. This was kept up till the sun's last limb vanished below the horizon. As he gradually sunk to rest their voices and movements grew fainter and fainter, till the last ray from his face was gone, when they all threw themselves flat on their faces and remained silent for some minutes, when they returned to camp.

My impression at the time was that these men had been under the tuition of some Parsee, as they would rise early in the morning and perform similar movements with their hands and bodies as the Parsees or fire worshipers.

They are fond of music, and make a small stringed instrument something like a guitar. It is made of a large calabash and a narrow piece of wood about two feet in length, and to one end of this the calabash is fastened, and on the other there are notches cut which take places of frets as in a guitar. The strings are made from the fiber of the banana, plantain, and *Yucca filamentosa*. These may be stretched or released by means of pegs or screws. The Hottentots play on this instrument with the fingers of the right hand. The end of the calabash is pressed closely to the breast when played.

In going through the forest one morning, I was surprised to hear a voice of a human being in such a lonely spot. Some one in the distance was singing a plaintive song, which sounded wild, weird, and mournful. I took my steps in the direction of the sound, and soon came up with a stalwart Hottentot playing and singing at the top of his voice. I accosted him, although he at first took little notice of me. I succeeded, however, in securing his instrument for a small sum of money, and brought it home for our national museum.

They make a small whistle or flute from the willow bark, also a drum from a hollow log by stretching a sheep's skin over one end of it, which they call the kora or sua kora. Oftentimes the family's iron pot is brought into requisition by stretching a skin over it, as it answers the purpose. It is beaten with the first two fingers of the right hand, which produces a dull, heavy sound. To this they dance in the following manner: A string is fastened to the top of the kraal; the end is seized by the dancer with both hands. When the music commences they raise first one foot and then another, slowly increasing with the time of the music, till they hop round pretty lively, singing at the top of their voices, gyrating, and placing their bodies into every conceivable position that can be imaginable, not unlike dances which I have seen performed by our North American Indians. The drum is similar to that used by the native of India and which they call the tom-tom. All colored nations are fond of noise, particularly the Hottentots, who believe that it keeps away something that is harmful to them. What that is they cannot describe to you.

They inter their dead in graves, over which are set tortoise shells filled with odoriferous powder and twigs of shrubs that are fragrant, and, after this, the mourners, who form a procession, make merry by singing and dancing. Gout and dropsy appear to be the principal diseases in the country, proceeding from the quantities of very common wine they drink and the varying cold winds which prevail.

A very curious custom prevails among these people. When a child is born it is washed twice a day with a decoction from the root and leaves of a plant. Meanwhile a fire is kindled and incense made from leaves and twigs of a particular kind of a tree. Over this cloud of smoke the child is held until it is thoroughly dry, after which it is bedaubed with pot clay or with a mashed snail. This process is continued for about a fortnight, and is said to possess a medicinal virtue. Before the mother returns to her daily avocation a bullock is killed. On the day it is slaughtered every vestige of the meat is placed in the hut in which the infant's voice was first heard. There it is supposed to be inspected by the spirits of the ancestors, so that they may be congenial of the handsome sacrifice performed. On the following day neighbors and friends assemble and devour the meat, except one leg, which is the lawful property of the doctor who prescribed for the mother when she was *enciente*. The skull of the sacrificed animal, with its horns, is then suspended from the roof of the hut for several weeks. It is exceedingly difficult to conceive in what way the ancestors are propitiated by this act.

It is a custom among many of the African tribes that, if a cow is barren, she must be killed, but in this case the meat must not be eaten except by married people. Of game that has been killed no one is supposed to eat before he is invested with the dignity of man, nor must man or wife eat any part of the animal's heart or pericardium. If a woman is barren, her husband can put her by and take another that will bear him children. Oftentimes the barren wife is allowed to remain as a servant, to do the dirty work. The men will not drink milk that has been drawn by a woman from a cow.

The great influx into southern Africa of the Dutch emigrants in the seventeenth century, bringing with them all the vices of the white man, particularly rum and tobacco, of which all the colored races are very fond, seemed to demoralize these poor, harmless negroes, who at this time were living at peace with each other, with only occasionally a little difference with neighboring tribes. It was like sounding the death knell to them. Soon the whites got from them all their land and cattle, and the tribes became perfectly demoralized. Scattered over the lands, they were discouraged, and now it is hard to find a pure-blooded Hottentot, except on the outer border of Kaffirland. It is the same old story which is now taking place in our own country with the Indian, as it will be but a few years before they, too, will be numbered with the past.

THE total area now planted in sugar beets in Europe is estimated at 3,300,000 acres, and the estimated yield of sugar from these beets is 3,400,000 tons, or in round terms 2,250 pounds of sugar per acre.

## APPARATUS FOR THE CONCENTRATION OF SULPHURIC ACID.

WE illustrate herewith a new apparatus, devised by Mr. L. Kessler, for the concentration of sulphuric acid, and which has recently been exhibited to the Society of Encouragement.

This apparatus, which is a great improvement upon the analogous arrangements that have given Messrs. Faure & Kessler so just a reputation in France and other countries, is based upon the use of superheated gases put in direct contact with the acid to be evaporated.

Mr. Kessler has found that if hot gases are made to pass over sufficiently wide surfaces of concentrated sulphuric acid heated to its boiling point, say toward 328° C., the total evaporation of the acid or its concentration at 66° Baume is obtained at temperatures inferior to its ebullition in a vacuum, say toward 170° C.

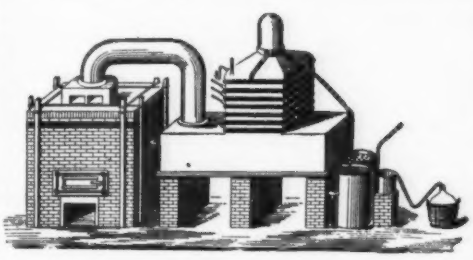


FIG. 1.—KESSLER APPARATUS FOR THE CONCENTRATION OF SULPHURIC ACID.

It results from this, on the one hand, that the acid coming from the apparatus for concentrating to 66° established upon this principle carries off no more than 170° instead of 328°, and that the vapors carry to the exterior likewise only a feebler quantity of lost heat. Besides, in using over again the gases coming from a last concentration, at the desired maximum, for several other graduated evaporations, it is possible, with the same expenditure of heat, to let these gases escape only at a temperature much below 100°.

On another hand, in exchanging the temperatures of the two ingoing and outcoming acids, hardly any of the heat that escaped with the concentrated acid is lost; whence results a great saving in fuel.

By reason of the slight elevation of the temperature of the evaporated acid, Mr. Kessler causes it to make its exit through a lead pipe but slightly cooled.

This apparatus might have been constructed entirely of lead, but, since the acid dissolves so much the more of the sulphate of this metal in proportion as it is more concentrated, it was preferred to construct it of carved sandstone or stoneware. There is thus obtained an acid that contains no more lead after its concentration than before.

In practice, it suffices that the three bottom cells be of sandstone, those superposed, wherein the acid does not exceed 110°, being capable, without inconvenience, of being of lead.

In the evaporator in operation at the works of Messrs. Faure & Kessler, at Clermont-Ferrand, the acid arrives directly from the chambers, passes into the temperature exchanger, where it is heated by the outgoing acid, enters the apparatus at the top and descends successively in a cascade into four superposed leaden trays, and then into three other trays of carved silicious stone. In each of these seven trays the acid is put in contact, over very wide surfaces, through bubbling, with the heated air, which expels the water from it. It makes its exit from the lower compartment through a leaden siphon, which leads it to the temperature exchanger. Upon making its exit from this, it is received directly in the shipping carboys, or else it is made to pass into a small supplementary refrigeratory, whence it is drawn in a colder state.

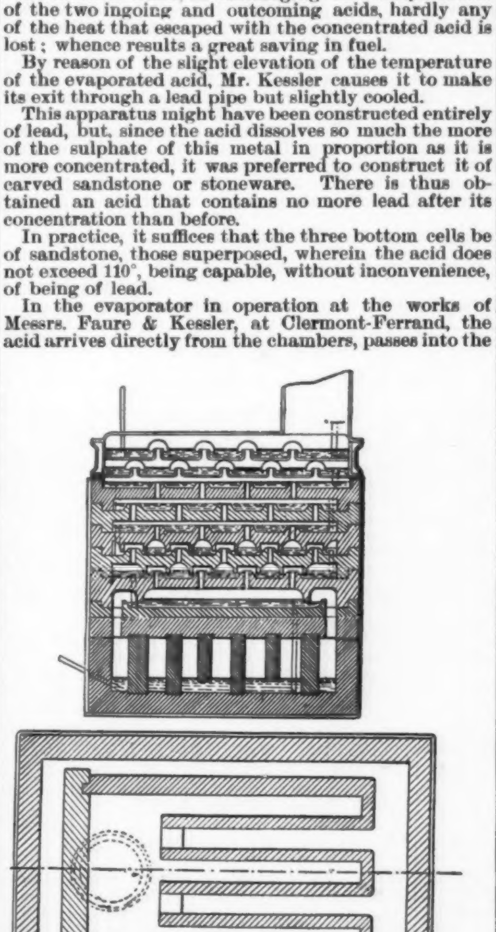


FIG. 2.—SECTION AND PLAN.

The heated gases are furnished by air burned in a generator of oxide of carbon, which is charged with coke once a day. They are drawn into the evaporator by a steam suction apparatus. The degree of the acid is regulated by the readings of two thermometers, one of which is placed in the second stone tray and the other in the last leaden one. The vapors pass into a leaden receptacle filled with coke, wherein they give up water of 3° or 4° through the effect of simple contact, without the necessity of cooling them, the sulphuric acid not being volatile and the steam alone escaping.

The consumption of coke is about 17 lb. to 220 lb. of acid raised from 52° to 66° Baume.

This apparatus, according to the experiments made, does not diffuse any emanations through the works, and, moreover, no leakage can occur therein, since the external air is sucked in.

The acid, which is traversed by a current of gas charged with sulphurous acid derived from the combustion of the coke, is freed from nitrous compounds, and is white and limpid. It may be obtained as poor in lead as that in the chambers by leading it on its exit from the apparatus, by means of a pipe made of platinum, porcelain, terra cotta, or silicious stone, into a refrigeratory or into basins constructed of such materials.

The system of evaporation upon which this new apparatus is based is likewise valuable for expelling, at the lowest temperature, the sulphuric acid contained in certain substances that cannot support a great heat (110° to 115°), or that, above such temperature, would attack glass or porcelain vessels, like phosphoric acid.

Upon the whole, with this arrangement acid at 96 per cent. of monohydrity may be easily obtained. According to Mr. Kessler, it might serve with advantage as an evaporatory denitrating tower in place of the Glower tower, or replace the old leaden preparatory boilers for the concentration of sulphuric acid to 62°.—*Le Genie Civil.*

## ATTEMPT AT A GENERAL METHOD OF CHEMICAL SYNTHESIS.

By RAOUL PICTET.

IN order to develop from the totality of facts explained in my former papers a practical method of utilizing low temperatures in chemical syntheses, it will be useful to recall the partial laws which we have already seen.

The fundamental hypothesis which has guided us and the experimental verifications have enabled us to establish eight laws:

1. At very low temperatures, below —130°, no chemical reaction takes place, whatever substances are present.

2. All chemical reactions are manifested spontaneously at a certain temperature and under a certain pressure exerted upon the constituents; this is the temperature limit.

3. The same reactions may be obtained below the temperature limit if we apply auxiliary energy by the use of electric currents or discharges.

4. Exothermic reactions always present two phases: in the former we retain a control of the temperatures if we can remove from the combining bodies, by radiation, as much heat as is produced at the same moment by the simultaneous effect of the affinities of the extraneous energies introduced into the substances. In the second phase, the temperature rises suddenly until the reaction takes place above the temperature limit.

The first phase is the reaction limit. The second phase is the reaction in mass.

5. Endothermic reactions are always limit reactions.

6. The dissociation of the products obtained by exothermic reactions corresponds to the laws of endothermic combinations and reciprocally.

7. The temperature limit of chemical reactions is not in a known simple relation with the apparent energy of the phenomenon. On the contrary, the quantities of heat liberated seem to class the ascending order of the temperature limit, especially in one and the same family of substances.

8. The electric spark and current seem to be the best media for supplying extraneous energy to limited chemical reactions.

With these eight partial laws we may establish a complete scientific programme for the discovery of a general method of chemical synthesis.

We begin by bringing in contact the simple bodies, and defining experimentally the laws which govern their combinations, the relations between their temperatures, the pressures, and the quantities of heat to be supplied in limited reactions.

As the first series of observations must, on principle, give precise numerical values, we must never allow reactions in mass to interfere, as they disturb and modify the thermic conditions of the phenomenon. This condition, *sine qua non*, indicates at once the plan of operations to be followed. The chemist must have at command a powerful refrigeratory apparatus, by which he can at least reach temperatures of —130° to —150°, so as to paralyze all chemical reaction. Substances thus cooled are certainly below all the temperature limits.

The refrigerating tank must have a temperature which can be regulated at will from —130° to the ordinary temperature.

A powerful induction coil yields sparks which must be made to strike, by means of insulated conductors, through the substances to be combined, in the refrigerated inclosure.

When the reaction commences, the heat produced each moment by the weight of the compounds obtained must be withdrawn by radiation, so that the temperature at which the reaction is produced may be kept constant.

The quantities of energy represented by the electric current in amperes and volts are equivalent to the endothermic phase of the reaction. The quantities of heat lost by radiation measure the exothermic phase.

The calorimetric measure effected in the refrigeratory enables us to know directly the effect of radiation for all the differences of temperature.

We shall on this principle constitute the first rational dynamic table in chemistry, by studying all the simple bodies two by two, three by three, etc. By combining by the same methods, and with the same appliances, the binary bodies with the simple bodies, we

obtain the second dynamic table. Next we pass to the ternary substances, etc.

The successive experiments will discover the laws which govern the phenomena, and will in so far facilitate the knowledge of the utilization of the dynamic tables.

The line of the greatest chemical declination of all bodies will thus be determined experimentally.

Chemical reactions will be defined in a manner as precise and certain as the fall of a body on an inclined plane by a single track without ambiguity. We shall know beforehand, for any reaction which we may wish to produce, all the conditions to be fulfilled so as to obtain only a single effect, *e. g.*, the fixation of a new element upon a given primitive nucleus.

The track will be known and the result certain. Under this form we see the possibility of forming rationally by direct synthesis all the substances in nature.

It is probable that along with the electric spark we may utilize other sources of auxiliary energy, *e. g.*, the collateral chemical reactions produced in the series of substances studied, and which will yield a known number of calories. The subject of this immense research is scarcely touched upon; we have confined ourselves to lay down its principal lines.

The present experimental results give a preliminary sanction to this programme.

In concluding the exposition of these general views on the phenomena of ponderable matter, we see that the same equations of motion may represent as a simple function of distances:

1. All astronomy and the phenomena of gravitation, the distance of bodies which attract each other, passing from infinity to distances where the action of the ether manifests itself to modify the law of Newton.

2. All cohesion where the totality of the physical phenomena of changes of state linked to calorific phenomena where the distances of the attracting bodies pass from the limits of gravitation to the distance of bodies refrigerated to the absolute zero.

3. All chemistry, phenomena of motion, when the distance of the attracting bodies is smaller than that observed at the absolute zero.

The equations of the movement of matter permit us thus to reduce these three sciences to a single formula, the numerical terms of which are not yet known, but from which we may logically deduce every observable phenomenon.—*Comptes Rendus*, cxvi. p. 1057, *from Chem. News*, 1893, 279.

## AN IMPROVED METHOD OF PURIFYING TOLUOL, BENZOL, ETC.

By R. J. Friswell.

Of late years the demand for toluol has so much increased that large quantities of the by-products from the oil gas factories have been worked up to recover the toluol and benzol which Armstrong some years back discovered in them.

This has caused much trouble in separating traces of paraffins, which, though not so troublesome with benzol, render toluol almost unworkable, unless treated in a special manner. These substances are not indicated by any variation of the boiling points, which are now uniformly good, but can be at once detected by vigorously shaking the sample with an equal volume of pure sulphuric acid of 1·842 sp. gr.

Under these circumstances a sample made from pure coal oils separates sharply into two layers when allowed to rest after shaking, and the acid is colorless or of a very faint brown tint, and so remains for twenty-four hours or more.

On the contrary, the samples contaminated with these bodies form an emulsion, which takes five to ten minutes to separate completely, and the acid is more or less bright orange-colored. In about one hour the surface of the acid is deep green, and this tint gradually spreads through the liquid, so that in ten to twelve hours the whole is deep green or even black, while a distinct odor of sulphurous acid is easily detected.

A sample of toluol behaving in this way may be at once rejected by any one desiring to avoid an immense amount of trouble in working it.

It is, however, an easy matter to render toluol quite equal to the best samples prepared from pure coal oils by a very simple and inexpensive treatment.

It is, of course, well known that agitation with concentrated oil of vitriol will effect the removal, by solution, of most of these bodies; but, unfortunately, at the same time great loss of toluol occurs, owing to its easy solubility in the acid. Its recovery by hydrolysis is, needless to say, an expensive operation.

It is no secret that many makers have used fuming acid, and have alleged that, notwithstanding increased loss, it has proved cheaper to use than ordinary vitriol. The use of oxidizing agents dissolved in the vitriol has been found quite ineffective.

The movement in the direction of stronger acid is an entirely erroneous one, and the secret of success lies in an opposite direction.

It is quite possible to employ an acid too weak to dissolve the toluol, but quite strong enough to wash out the paraffins; but this treatment is rendered expensive by reason of the large volume of acid and number of treatments required. It is, however, possible to make use of an acid which shall act in a different manner, viz., render the paraffin-like bodies, part of which it dissolves, much less volatile by polymerizing them.

This may be carried out as follows: Crude toluol boiling between 110° and 130° C. is agitated thoroughly for four hours with 10 per cent. by volume of sulphuric acid of sp. gr. 1·803. It is allowed to rest, and drawn off from the acid in the usual manner and washed once with enough caustic soda to remove traces of acid. Very thorough agitation is necessary, and certain samples may require more acid or a longer time of treatment. The loss should not exceed 5 per cent.*

It is then at once transferred to the rectifying still, and the pure toluol taken off. This will be found by the acid test quite equal to the best toluol made from coal oils. In fact, 95 per cent. of the distillates will pass this test.

The residues in the still consist partly of the polymerized bodies, their boiling points lying between 260° and 285° C.

The waste acid on dilution deposits a deep green oil, which, when nearly free from acid, is soluble in water. When distilled with water a very heavy oil comes over with the distillate. The acid cannot be recovered unless this substance is separated by dilution, as, if heated directly as drawn from the toluol, it evolves large volumes of sulphurous oxide and becomes nearly solid from separation of carbon.—*Chem. News.*

* About half of this is due to the paraffins removed.



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